

RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

Vol. 67

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No. 4

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RADIOLOGY

A MONTHLY PUBLICATION DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

PUBLISHED BY THE RADILOGICAL SOCIETY OF NORTH AMERICA

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Supervoltage. Should We Junk 250 kv? A Symposium¹

J. W. J. CARPENTER, M.D., Moderator

THE MEMBERS of the panel for this discussion of supervoltage therapy need no introduction. They have been selected for their long and extensive experience in supervoltage and, perhaps, because they

would not attempt to answer the questions that may arise on a mathematical basis. Rather they have chosen to present a number of cases that they feel will illustrate their points.

Two Cases Treated with 800 kv and 400 kv, Respectively²

SIMEON T. CANTRIL, M.D.

As my contribution to this Symposium, I shall present 2 cases, one of oral carcinoma and one of carcinoma of the cervix, representing different indications for therapy.

CASE I: A 65-year-old male was seen in October 1950, in excellent general condition, but with an extensive primary epidermoid carcinoma, Grade II, involving the right lower alveolar ridge throughout its length, with infiltration of the entire right floor of the mouth and right gingivobuccal sulcus and a large metastatic submaxillary lymph node open and draining to the skin (Fig. 1). There was roentgen evidence of destruction of the right side of mandible for a distance of 2.5 cm. (Fig. 2). No previous irradiation had been given. The patient was edentulous.

Irradiation with 800 kv (h.v.l. 3 mm. Pb) was given through a single right mandibular and submaxillary field of 6 X 7.5 cm., to include the primary carcinoma and the right submaxillary metastasis. In thirty-seven days 6,035 r (measured on skin) was given through this field; the minimal dose to the deepest portion of the growth at the junction of the floor of the mouth and the tongue was 4,800 r.

The skin reaction was no more than an erythema,

and the anticipated membranous reactions of the right buccal wall, floor of the mouth, and right lateral border of the tongue were well tolerated. Observation over a three-month period following irradiation showed continued regression of the soft-tissue disease of the oral cavity, with a remnant of infiltration at the posterior margin of the buccal wall where it joined the vertical ramus of the mandible; apparently complete resolution of the disease in the gingivobuccal sulcus; closure of the draining sinus and palpable resolution of the metastatic lymph node. Three months after completion of irradiation, surgery was performed by Dr. Frank Wanamaker, consisting in segmental resection of the horizontal ramus of the mandible, together with adjacent soft tissues of the buccal wall, and unilateral suprathyroid neck dissection. The tissues healed well, with good functional result.

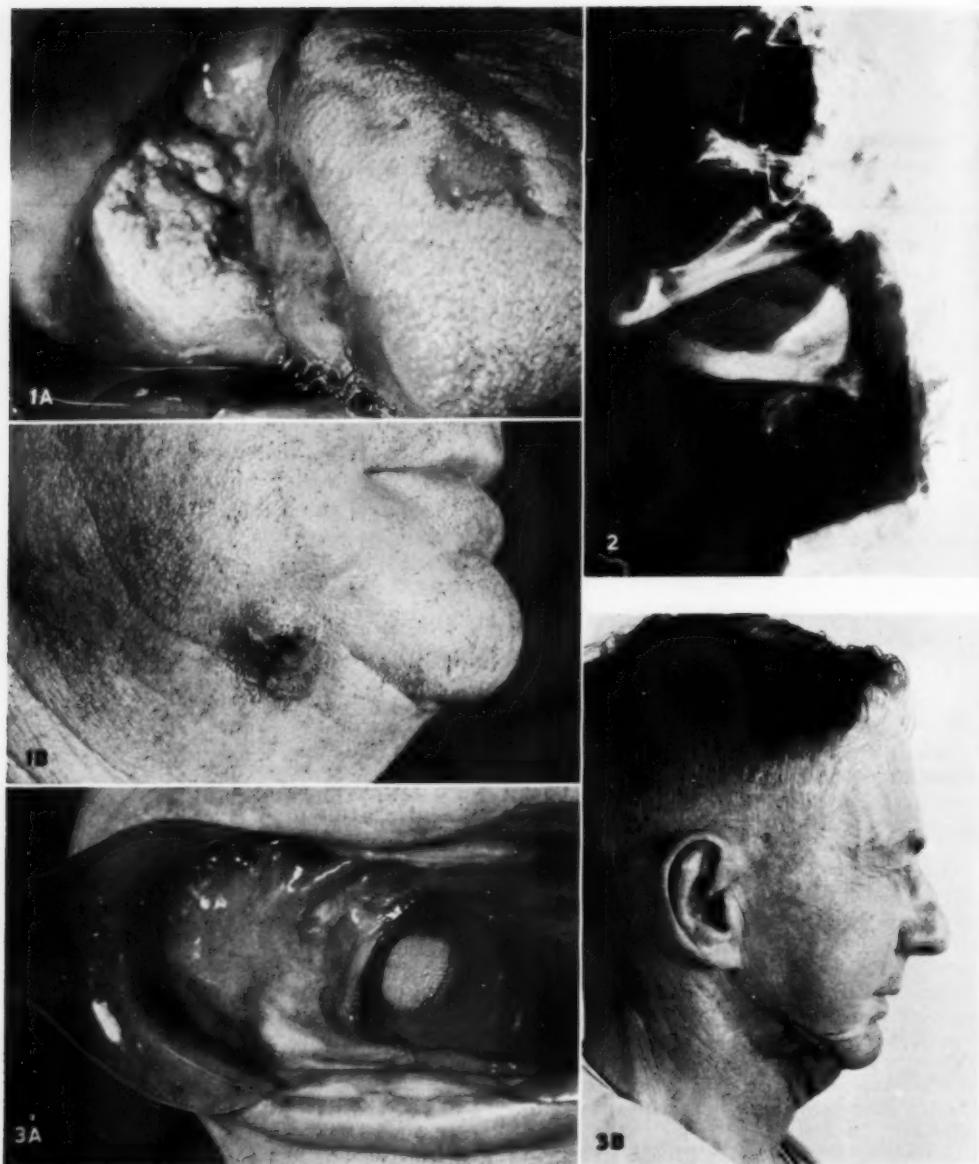
Pathologic studies showed residual epidermoid carcinoma only in the soft tissue at the site of the local remnant of infiltration of the buccal wall. No evidence of residual cancer was found in the submaxillary tissues or mandible.

The patient has remained well over five years, without sequelae secondary to irradiation and with a satisfactory functional result (Fig. 3).

Supervoltage irradiation was chosen for

¹ Presented at the Forty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 11-16, 1955.

² From the Tumor Institute of the Swedish Hospital, Seattle, Wash.



Case I

- Fig. 1A. Carcinoma of right gingiva with infiltration of the gingivobuccal sulcus and floor of the mouth.
 Fig. 1B. Metastatic submaxillary lymph node with spontaneous drainage.
 Fig. 2. Infiltrative erosion of the mandible below the gingival carcinoma.
 Fig. 3A. Status of oral cavity five years after treatment.
 Fig. 3B. Site of irradiation and segmental mandibular resection with suprathyroid neck dissection five years after treatment.

this patient for the following reasons: (1) the desirability of irradiating the primary lesion and its metastatic focus

through a single field, (2) the necessity of irradiating a mandible already compromised by infiltration of carcinoma, (3)

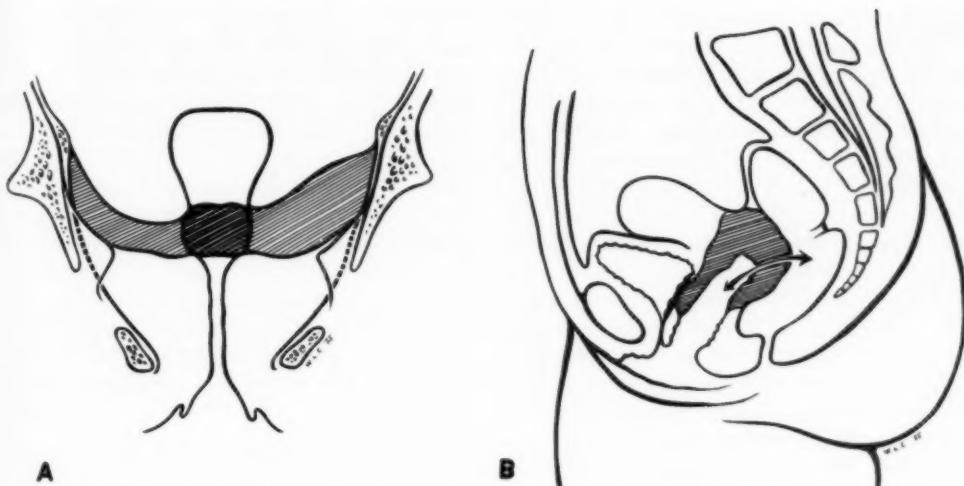


Fig. 4. Case II. Advanced endocervical carcinoma (Stage IV) with infiltration of the anterior and posterior vaginal walls, bullous edema of the bladder, and rectovaginal fistula. Dense bilateral infiltration laterally to pelvic wall. Note narrow vaginal canal.

the requirement of penetration through the mandible to reach adjacent soft tissues, and (4) the planning of later surgery within the field of irradiation, making it desirable to obtain conditions which would not too severely compromise radical surgery and healing.

CASE II: A 54-year old female (postmenopausal) was seen in January 1948, with a three-year history of pelvic pain. Associated symptoms were urinary urgency and frequency, marked weight loss, and a vaginal discharge of fecal odor.

The essential findings, apart from a very reduced general condition, were those defining Stage IV carcinoma of the cervix. There was an extensive endocervical carcinoma with a rectovaginal fistula. The ureters were not compromised, but cystoscopic examination showed a marked bullous edema of the entire trigone, consistent with the infiltration palpable in the superior vesicovaginal septum. The vagina was extremely narrowed, and there was a dense bilateral infiltration extending to the pelvic brim (Fig. 4).

The anatomic considerations here—an extremely narrow vagina with advanced pelvic disease and rectovaginal fistula—were not conducive to initial intracavitary radium or transvaginal x-ray therapy. External roentgen therapy seemed the initial procedure of choice. The anteroposterior pelvic diameter was 19.5 cm.

Over a period of thirty-eight days the patient received external irradiation with 400 kv (h.v.l. 3.7 mm. Cu) through two anterior and two posterior

opposing portals of 9 × 12 cm., with 2 cm. skin separation medially. The incident dose per portal, measured on the skin, was 3,000 r, with a minimal mid-pelvic dose at the periphery of the order of 2,400 r, and a maximum median dose of 4,000 r contributed by scattering of the four fields.

Complications incident to this therapy were urinary distress and rectal and intestinal irritation, with continued rectovaginal fistula, requiring hospitalization. By completion of irradiation, the infiltration in the anterior vaginal wall had changed little in consistency or extent. Two months later the rectovaginal fistula had apparently closed and the patient began to gain weight. At that time our record states: "It would seem that further therapy is not indicated in view of the good palliative result obtained to date." The patient's condition continued to improve. Cystoscopic examination approximately one year after irradiation showed no residual bullous edema. Unilateral softening of the pelvis occurred within eighteen months after irradiation, leaving an elastic infiltration on one side. This has diminished over the years, and seven years after irradiation the infiltration in the vesicovaginal septum is no longer palpable. The patient is now seen at yearly intervals and it seems likely that she has recovered from what originally appeared to be a hopeless condition.

Supervoltage irradiation here was apparently not essential nor would it have contributed to a lesser morbidity or better outcome in this case than was obtained with medium-voltage x-rays. With the quality of irradiation used, (a) a dose was

obtained within the rectum and intestine within the fields of irradiation sufficient to produce proctitis and enteritis with associated diarrhea; (b) the minimal dose within the pelvis was not dictated by factors inherent in the irradiation but by the adverse by-effects of the irradiation, which mitigated against a higher dose, with greater morbidity in a patient already in a poor general condition; (c) the reaction of the skin was not severe and was not a deciding factor in the cessation of treatment; (d) in this patient constitutional symptoms of radiation sickness were not paramount. An erroneous initial appraisal of the prognosis here did not take into account the probable large in-

flammatory component and the unknown and unpredictable biologic response of this carcinoma to irradiation, which is the factor above all which permitted the result obtained. This biological response to the minimal dose achieved would not have been enhanced by supervoltage irradiation. Had the patient been of a size in which the depth dose by medium voltage irradiation would have been more difficult of achievement, then supervoltage irradiation might have been utilized for its depth considerations without adding to or subtracting from either the complications or end-result.

Tumor Institute of the Swedish Hospital
Seattle 4, Wash.

The Superior Value of Supervoltage Irradiation in Special Situations: Carcinoma of the Mouth and Carcinoma of the Testis¹

MILTON FRIEDMAN, M.D.

The purpose of this Symposium is to ascertain whether cure rates are sufficiently increased by supervoltage irradiation to warrant the installation of supervoltage apparatus in all radiation therapy departments. After thirteen years of clinical experience with this modality, I find two types of supporting evidence: the individual case of arrest of an unusual, advanced cancer known to be intractable to more common methods, and the statistical series confined to a single type of lesion. I shall present here a case of multiple intraoral cancer and two types of carcinoma of the testis, radiosensitive seminoma and radioresistant trophocarcinoma (embryonal carcinoma).

The theoretically developed support of the value of supervoltage irradiation is being modified through clinical testing as a result of unexpected and paradoxical observations.

THREE SUCCESSIVE INTRAORAL CANCERS: CASE REPORT

On Nov. 5, 1951, a white male, aged 82 years, was seen with a lump in the right side of the neck of two

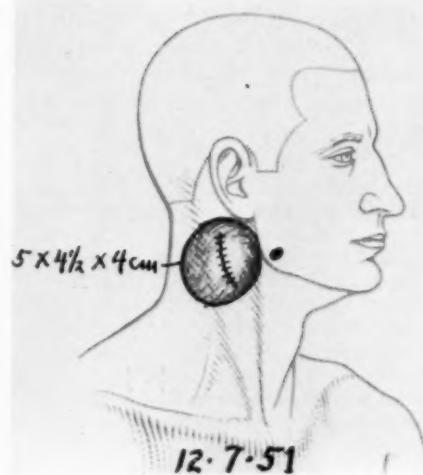


Fig. 1. The large cervical node, fixed to the deep structures of the neck, was the first manifestation of the disease. The tiny primary tumor in the glossotonsillar groove was discovered subsequent to the operation. It was not visible but was palpable.

weeks duration. Two weeks later it was explored surgically. It proved to be inoperable, and a biopsy specimen was removed. This was diagnosed as squamous-cell carcinoma. The mass measured $5.0 \times 4.5 \times 4.0$ cm., lay deep to the upper part of

¹ From the Radiation Therapy Department, Hospital for Joint Diseases, and Department of Radiology, New York University College of Medicine, New York, N. Y.

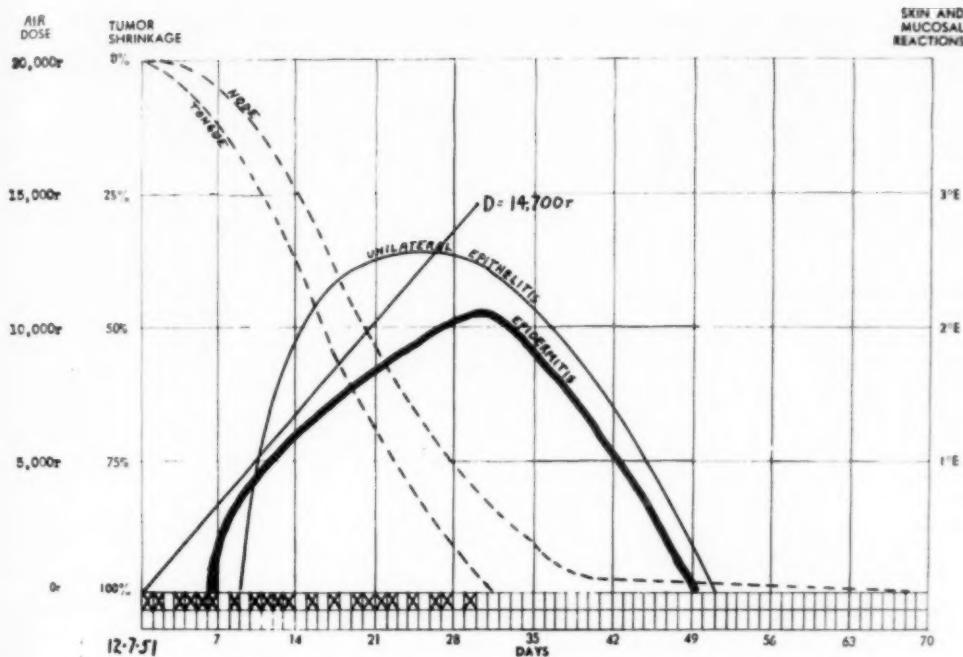


Fig. 2. Skin and mucosal reactions and tumor response from irradiation through a single portal grid (8 × 10 cm.) with a dose of 14,700 r (air) in thirty days.

the sternomastoid muscle, and was firmly fixed to the transverse processes of the upper cervical vertebrae. The primary tumor was subsequently discovered to be a small submucosal irregular nodule, 7 × 14 mm., deep in the right glossotonsillar groove. It was not visible but was palpable (Fig. 1). This was irradiated through a single portal grid, 8 × 10 cm., with alternate 1 × 1 cm. cut-outs, 40 per cent open area; 250-kv x-rays were employed, with a half-value layer of 1.5 mm. copper. The total dose was 14,700 r (air) in thirty days (Fig. 2). The primary tumor and node shrank and have not recurred to date (five years). The epithelitis reached a second degree intensity and healed by the forty-ninth day. A moderately intense unilateral epithelitis healed by the fifty-first day. These two features are mentioned because they represent the irradiation effect on those normal tissues which would later be traversed by a supervoltage radiation beam. Figure 3 shows the skin of the right neck four years after grid irradiation.

Approximately two and a half years later, on April 20, 1954, there appeared a second small superficial squamous-cell carcinoma in the left upper buccogingival sulcus (Fig. 4), measuring 1.8 × 1 × 0.8 cm. This was irradiated with 250-kv x-rays through an intraoral cone, 2.5 × 3.5 cm. diameter. The surface dose was 7,500 r (with back-scatter) in nineteen days. The tumor was radiosensitive, dis-



Fig. 3. Appearance of skin four years after grid irradiation. The primary tumor and metastatic node are now arrested for more than five years. The depigmentation and subcutaneous fibrosis with contracture indicate the severity of the late radiation changes produced by the grid. This region is to be traversed in the future by a beam of supervoltage x-rays.

appearing completely by the last day of treatment. This irradiation produced a localized severe second-degree epithelitis which healed by the fifty-sixth day after the first treatment.

The third lesion, which is germane to today's dis-

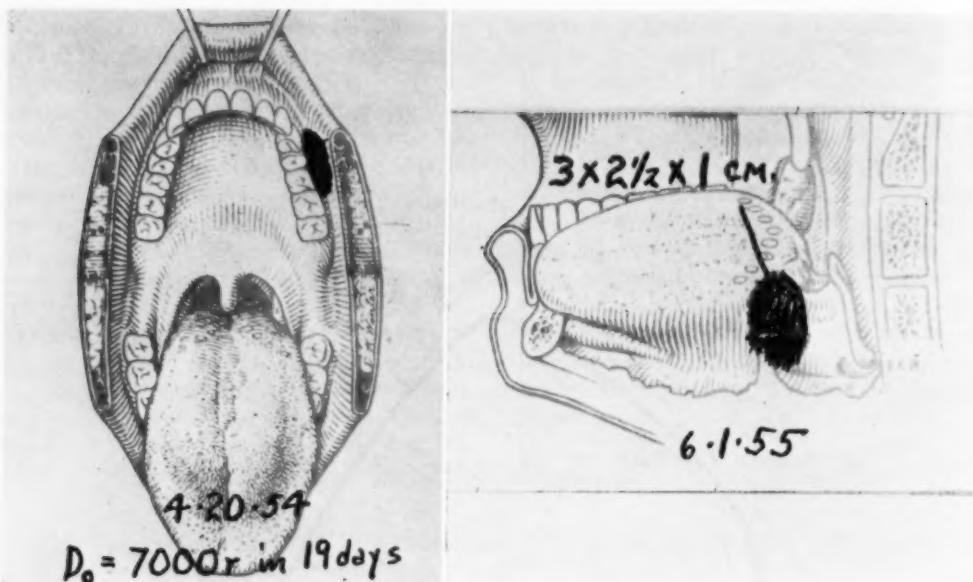


Fig. 4 (left). Second tumor in the left upper buccogingival sulcus successfully irradiated with a surface dose of 7,500 r (with back-scatter) in nineteen days through an intraoral cone.

Fig. 5 (right). Third squamous-cell carcinoma in a man who is now eighty-six years old.

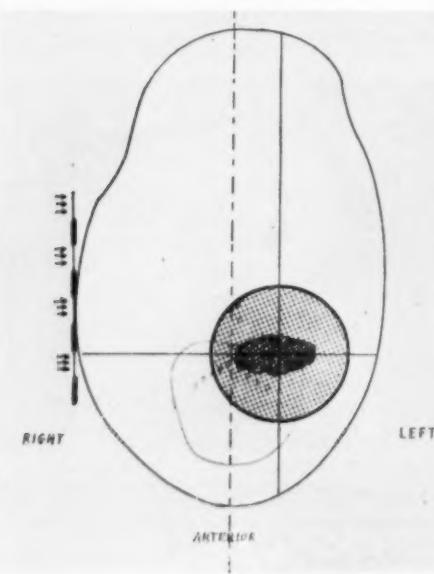


Fig. 6. Cross section of the head through the center of the third tumor on the dorsum of the posterior portion of the left half of the tongue. The position of the previous grid portal is indicated. The circle with cross-hatching indicates the 5-cm. diameter cylinder which was intensely irradiated with 2,000,000-volt x-rays by the rotation technic. The tumor dose was 9,578 r in thirty-nine days.

cussion, was discovered June 1, 1955, in the course of a routine follow-up examination. It was an indurated plaque, visible only as a slight flat depression in the normal mucosa, but palpable as a 3 × 2.5-cm. plaque, 1 cm. thick, located on the dorsum of the left half of the posterior portion of the tongue, extending from the mid-line to the hypopharyngeal wall (Fig. 5). Histologically it was a squamous-cell carcinoma. The therapeutic problem is illustrated in Figure 6. From the previous grid therapy the region of the tumor had received tissue doses through the open holes of the grid ranging from 4,500 to 7,000 r, and under the closed areas from 2,500 to 3,400 r.

The patient was now eighty-six years old. It was decided to employ supervoltage irradiation with rotation technic. Using 2,000-kv x-rays and a target-axis distance of 125 cm., a concentrated volume of irradiation was delivered to a cylinder 5 cm. in diameter and 5 cm. high, encompassing the carcinoma on the dorsum of the tongue as indicated by the circle in Figure 6. The total tumor dose was 9,578 r in thirty-nine days. The biologic reactions are charted in Figure 7. The first-degree skin erythema was confined to the left side of the face. The epithelitis was sharply limited to a region 4 cm. in diameter, centering on the tumor. Although the epithelitis was almost of third-degree intensity, it healed by the seventieth day. Because of the small area and sharp circumscription of the reaction, this old man tolerated the irradiation well. He lost 10 pounds but promptly regained most of it.

At present, a year and a half later, he feels well and has only slight dryness of the mouth. The mucosa over the lesion is slightly pale and soft. There is no evidence of tumor.

Discussion: It is improbable that the third lesion in this patient could have been cured in any other way than by supervoltage rotation therapy. The heavy previous irradiation from the grid would

periphery of the irradiated cylinder. Beyond a small irradiated volume of 5 cm. diameter, the dose falls off from 95 to 40 per cent in 1.5 cm. The diffuse epithelitis which occurs with available cobalt bombs might not have been well tolerated by the previously heavily irradiated oropharynx.

Without rotation, this favorable result

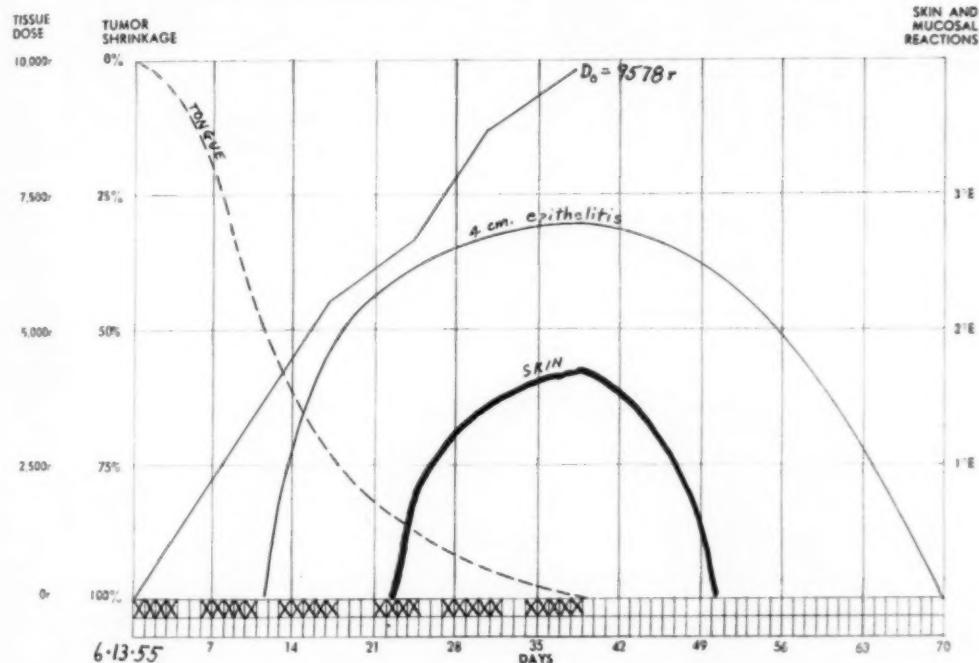


Fig. 7. Chart showing the reactions produced by the tumor dose of 9,578 r in thirty-nine days. The lesion in the tongue was radiosensitive and disappeared completely on the last day of treatment. The epithelitis was sharply confined to an area 4-cm. in diameter, centering on the tumor. The first-degree erythema was over the skin of the left neck only.

have rendered the tissues of the tongue intolerant to the "hot spots" of intense irradiation close to the sources if interstitial needles or seeds had been employed. Furthermore, the age of the patient and dryness of the pharyngeal mucosa from previous grid irradiation would have made intratracheal anesthesia dangerous or difficult.

A supervoltage x-ray machine was superior to a cobalt bomb in this instance because its minimal penumbra allowed rapid and sharp fall-off of dosage at the

could not have been achieved. Supervoltage irradiation is most efficient when a rotation technic is employed for relatively small volumes. By this means, large tumor doses—like the 9,578 r in thirty-nine days in the present case—can safely be delivered to many regions of the body.

Supervoltage rotation not only permits treatment of a new tumor with large doses through a previously irradiated area but also permits retreatment of a recurrent tumor following previous irradiation. We have had unusually fortunate

experiences of the latter type with recurrent meningioma of the cerebellopontine angle, carcinoma of the ethmoid, carcinoma of the thyroid, postlaryngectomy local recurrence, and recurrent lymph nodes following neck dissection.

SEMINOMA WITH METASTASIS

Seminoma is a radiosensitive tumor. A suitable tumor dose for many cases has

were required; the overall time was thirteen days instead of forty-nine, as a result of which the average tumor dose was reduced from 2,300 r (with 200 kv) to 1,875 r (with 1,000 kv), while still producing the same biologic effect; and finally there was no skin effect, whereas the larger skin doses of 200-kv x-rays produced a definite reaction.

Seminoma with widespread metastasis

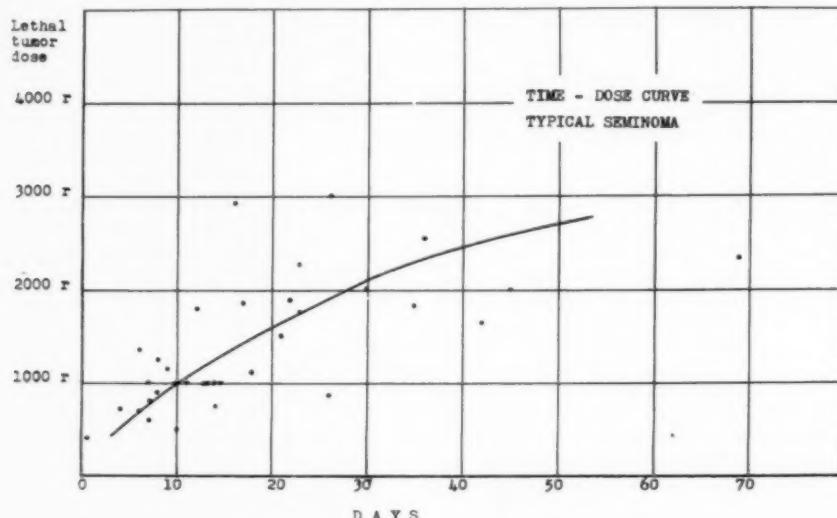


Fig. 8. Scatter diagram of tumor lethal doses in 35 typical seminoma lesions. The optimal dose is 1,000 r in ten to fourteen days. Occasionally large retroperitoneal masses are more resistant than average and may require tumor doses higher than 2,000 r. The average curve was drawn by free-hand. It is a useful clinical guide, but its slope has no statistical significance.

been demonstrated to be 1,000 r in ten to fourteen days (Fig. 8). A few tumors are more sensitive than average and some are more resistant. It is our arbitrary policy to administer tumor doses of 2,000 r prophylactically, because this larger dose is harmless. However, an occasional metastatic lesion, especially when it is very large, may recur despite this doubled dose (Fig. 10).

In administering 2,000 r to the retroperitoneal nodes several advantages of supervoltage radiation are readily apparent. Figure 9 illustrates the treatment given to two patients with similar lesions with 200-kv and 1,000-kv x-rays. With supervoltage radiation, fewer treatments

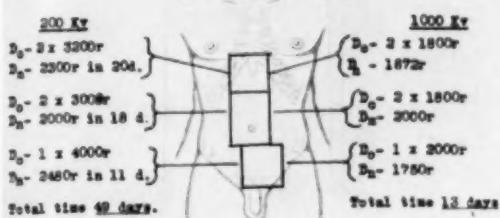
will rarely be cured with 200 kv. Recurrences are common because the prolonged overall time for the irradiation of deep-seated lesions reduces the effectiveness of the dose (Fig. 10) or else, while abdominal masses are being irradiated, other metastases appear elsewhere.

On the other hand, with supervoltage radiation it is easy—and common—to cure widely metastasizing seminoma. Figures 11 and 12 show patients who are free of disease from eight to twelve years. One of these (Fig. 12) had blood-borne metastases in two bones.

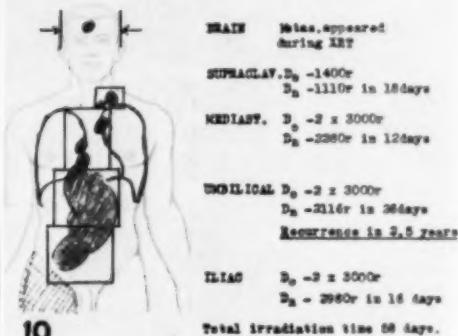
In a closed series of 94 seminoma patients (Table I) irradiated with 1,000-kv x-rays, the absolute five-year arrest rate

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COMPARISON OF 200 & 1000 KV.

9

200 KV IRRADIATION

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Fig. 9. Comparison of 200-kv with 1,000-kv. With supervoltage radiation, fewer treatments were required; the overall time was thirteen days instead of forty-nine days, and as a consequence the average tumor dose could be reduced from 2,300 r to 1,875 r, still producing the same biologic effect. Finally there were no late skin effects from supervoltage radiation such as were produced by the larger skin doses required with 200-kv x-rays.

Fig. 10. Case illustrating inefficiency of 200-kv irradiation for seminoma with widespread metastases. The upper abdominal mass recurred in spite of a tumor dose of 2,116 r because it took twenty-six days to deliver the dose to this region and the biologic effect was reduced. During irradiation of the abdominal masses, new lesions appeared in the mediastinum, supraventricular region, and brain.

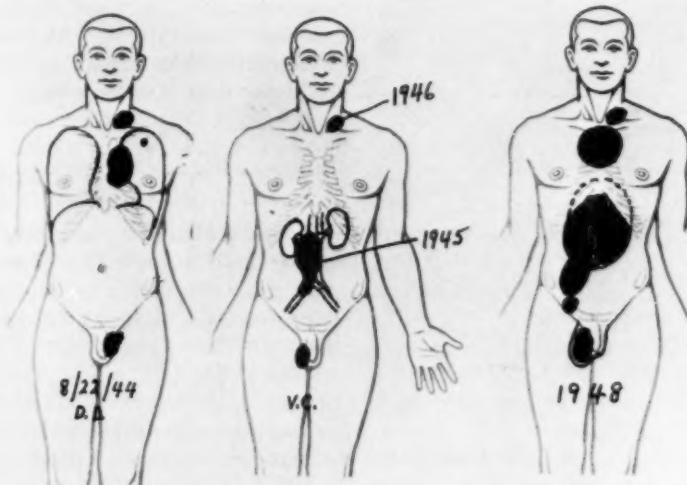


Fig. 11. Three seminoma patients irradiated with 1,000-kv x-rays and free of disease from eight to twelve years later.

was 83 per cent. The relative five-year arrest rate was 93 per cent. Only 6 patients died of metastasis. The other 10 died from large-dose irradiation effects. This occurred in our early years with

supervoltage radiation, when late effects were unknown and the dosage for testicular tumors not yet fully explored.

Another subgroup of 10 seminoma patients is of interest. After primary surgical

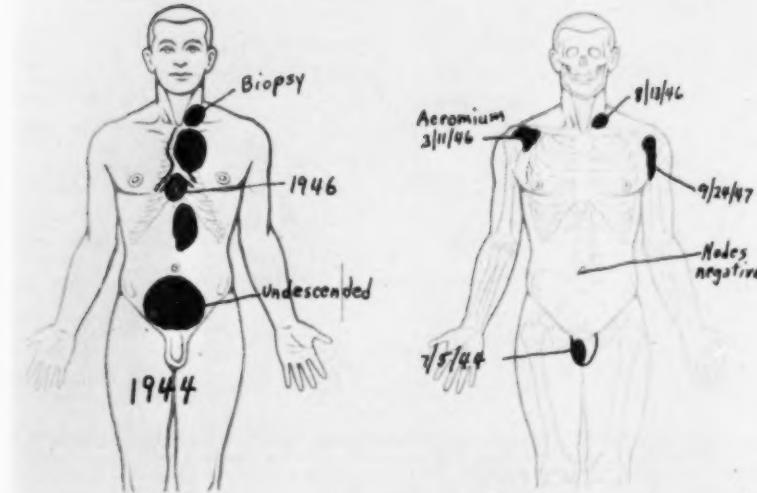


Fig. 12. Two patients with widespread seminoma irradiated with 1,000-kv x-rays and free of disease for twelve years since the institution of treatment. The patient on the left had a primary tumor in an undescended testis in the pelvis. The patient on the right had blood-borne metastases in two bones.

TABLE I: SEMINOMA (TYPICAL). ABSOLUTE FIVE-YEAR ARRESTS IN 94 CASES*

	Number	Per Cent
Five-year survivals (all cases).....	78	83
85 cases in which preoperative work-up showed no metastasis.....	76	89
67 cases in which at no time was there metastasis or recurrence.....	60	88
27 cases where there was metastasis, recurrence, or a secondary primary tumor in opposite testis.....	18	67

* The relative five-year arrest rate is 93 per cent, a figure based on 84 cases. Ten patients were eliminated because death was due to radiation injury or radiation sarcoma. They were overdosed due to lack of knowledge of required dosage and late effects of supervoltage radiation. Only 6 of 94 patients died of metastasis.

and radiation treatment had been completed, remote metastases or new tumors appeared months or years later (Table II). All were irradiated with supervoltage x-rays and all lesions have been arrested.

To summarize: With supervoltage irradiation of seminomas it should be possible to achieve an absolute five-year-arrest rate of more than 90 per cent. The cure of advanced disease should be a common rather than a rare occurrence. For early

seminoma (*i.e.*, primary tumor with no evidence of metastasis) the five-year-arrest rate with 200-kv x-rays is only about 10 to 15 per cent less than with supervoltage x-rays.

RADIORESISTANT TROPHOCARCINOMA AND TERATOCARCINOMA OF THE TESTIS

Trophocarcinoma and teratocarcinoma of the testis are useful lesions for comparing 250-kv and supervoltage radiation because of the necessity for delivering large doses for their destruction.

The tumor-lethal dose for trophocarcinoma is 4,000 to 5,000 r in four to six weeks, as has been substantiated by numerous observations. Figure 13 illustrates the slight

TABLE II: SEMINOMA. FIVE-YEAR ARRESTS WHEN METASTASIS APPEARED AFTER COMPLETION OF TREATMENT

	No. Cases	Per Cent Survivals
Remote metastasis.....	7	100
4 without retroperitoneal nodes		
3 with retroperitoneal nodes		
New tumor in opposite testis.....	2	100
Recurrence in scrotum.....	1	100

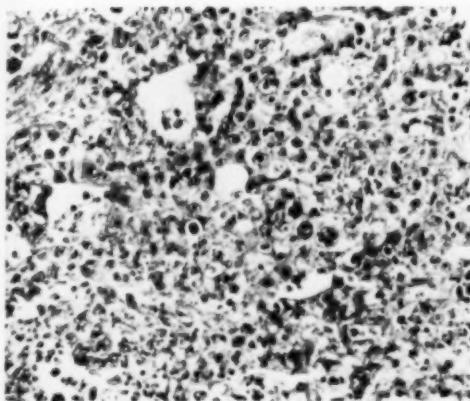


Fig. 13. Undifferentiated trophocarcinoma of the testis which received a tumor dose of 1,000 r in fourteen days and was removed six days later. The minimal irradiation effect indicates that the necessary tumor-lethal dose must be substantially greater than this (see Fig. 14).

histologic changes produced in an undifferentiated trophocarcinoma by a tumor dose of 1,000 r in fourteen days prior to orchietomy. Metastatic lesions in the lung (Fig. 14A) in the same patient required a tumor dose of 4,400 r in five weeks for eradication (Fig. 14B). Similar large tumor doses are necessary for other varieties of trophocarcinoma, such as choriocarcinoma (Fig. 15). For the teratoid structures in teratocarcinoma the tumor-lethal doses range from 2,400 r for immature cartilage to more than 5,000 r for some mature glandular structures (Figs. 16 and 17). These few examples indicate that most radioresistant non-seminomatous tumors of the testis require doses of 4,000 to 5,000 r or more in five to nine weeks for their eradication.

With 250-kv x-rays it was seldom possible to influence these radioresistant tumors favorably because of the inability to deliver large enough tumor doses. With supervoltage apparatus, one's goal and philosophy of treatment change. Instinctively one proceeds toward radical irradiation therapy, delivering large tumor-lethal doses to deep-seated tumors. Instead of palliation, the aim is cure. The difference is comparable to that between a Model T Ford, which can be driven at thirty to

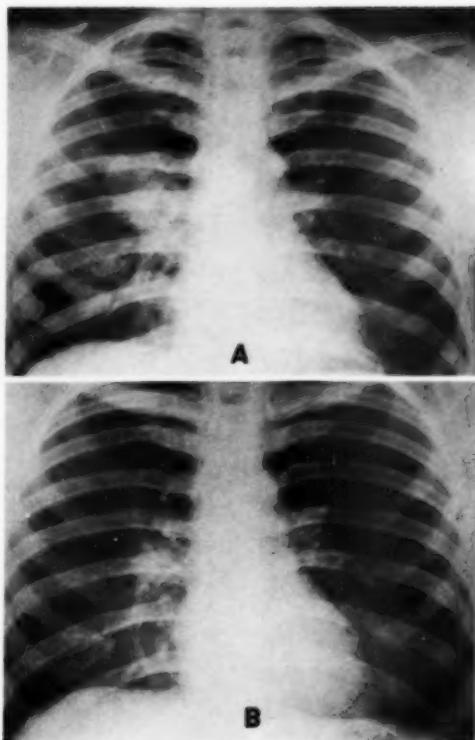


Fig. 14. A. The same patient as in Fig. 13. Multiple metastatic nodules in the lung.

B. The same patient as in A. A tumor dose of 4,400 r delivered in five weeks was required to destroy the metastatic lesions of this undifferentiated trophocarcinoma.

forty miles an hour, and a Cadillac in which you race along at sixty to seventy miles an hour.

I have demonstrated that in irradiating retroperitoneal nodes secondary to non-seminomatous tumors, doses of 4,000 r to 5,000 r in fifty to seventy-five days are required. The retroperitoneal nodes are partly surrounded by delicate gastrointestinal epithelium, kidneys, and spinal cord. Let us see what occurs when retroperitoneal nodes are heavily irradiated.

With anterior and posterior crossfiring portals, an interesting paradox is encountered. Supervoltage radiation is supposed to spare the skin. Figure 18 illustrates the late effects of 200-kv x-rays for a skin dose of 4,000 r in eight weeks. The early reaction was a severe erythema. In later

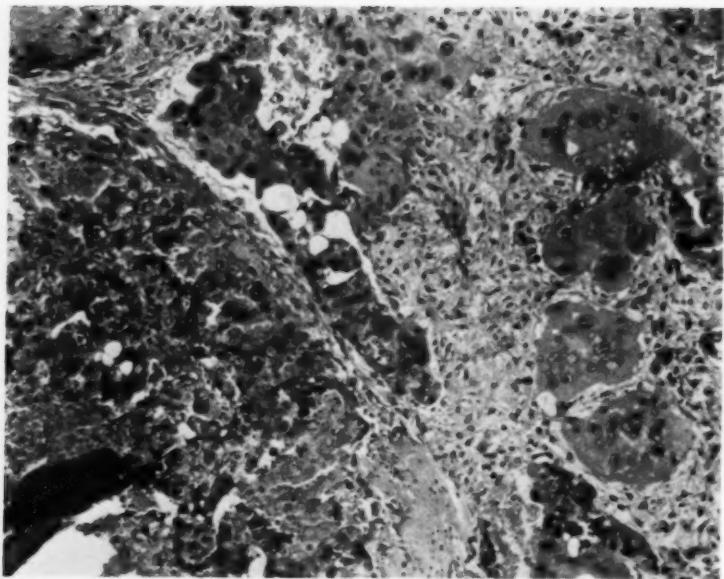


Fig. 15.⁴ Chorioepithelioma of the testis. A tumor dose of 1,000 r was delivered in four days and the testis was removed three days later. Photomicrograph shows no evidence of radiation effect. The tumor-lethal dose for a typical chorioepithelioma is approximately 5,000 r.

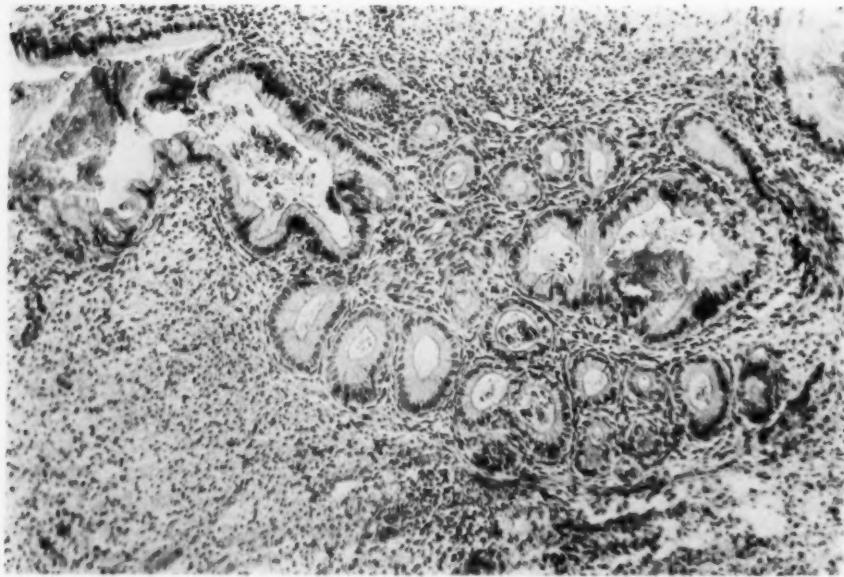


Fig. 16. Entodermal glandular structures in a teratoma of the testis which received a tumor dose of 1,000 r in ten days and was removed four days later. There are no radiation effects. These normal appearing mature teratoid structures are as radioresistant as normal structures in an adult.

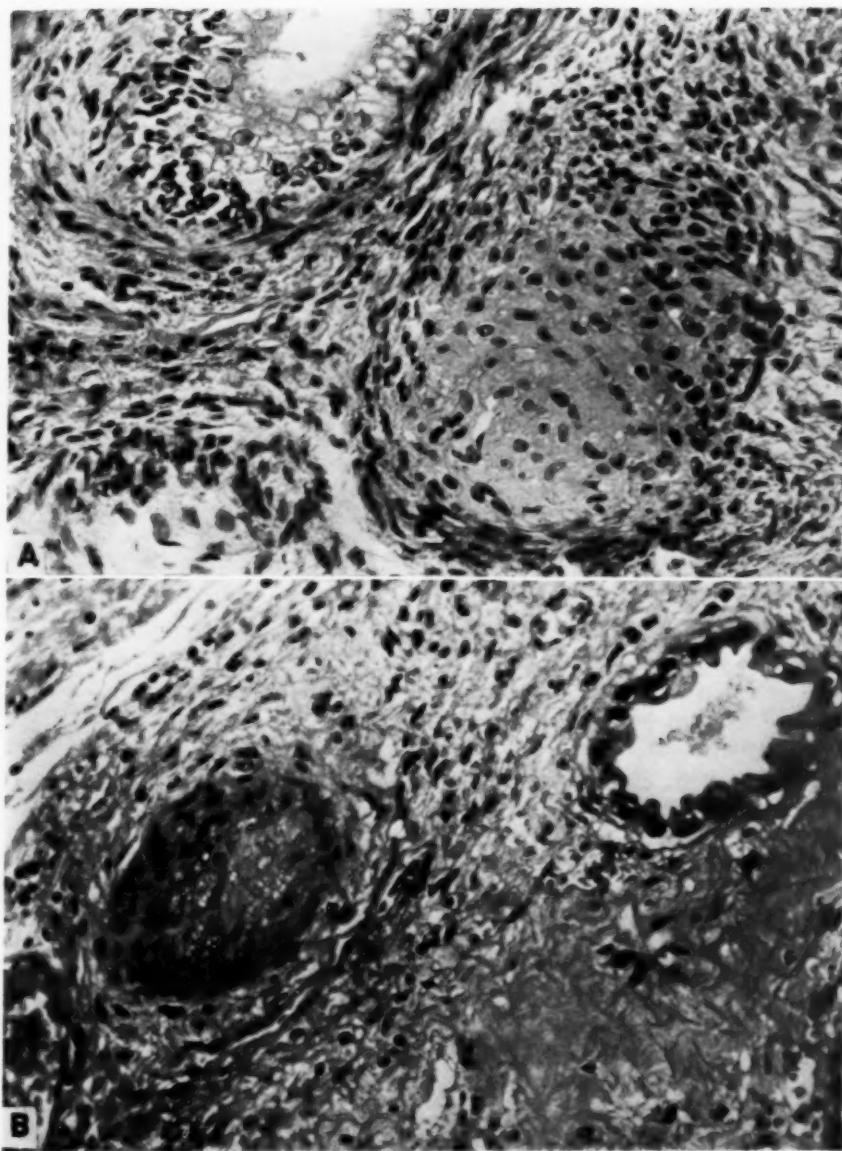


Fig. 17. A. Lung anlage in a teratoma of the testis. An island of embryonal cartilage is seen adjacent to an acinus lined with goblet cells.

B. Lung anlage from the same patient, in a supraclavicular node which received a tumor dose of 2,430 r in fifteen days and was removed five days later. The island of cartilage cells was radiosensitive. The chondroblasts were destroyed, leaving behind clear spaces in the center. On the right is an acinus lined with entodermal epithelium, which was radioresistant and showed slight radiation effect. This variation in radiosensitivity accords with the response of similar normal structures to irradiation.



Fig. 18. Appearance of skin several years after a skin dose of 4,000 r in eight weeks with 200-kv x-rays. The telangiectasis, atrophy, and irregular pigmentation are confined to the epidermis. There is little or no subcutaneous fibrosis. Although the early erythematous reaction was severe, the late effects were mild because of the superficiality of the radiobiologic effect.

years there appeared superficial telangiectasis and mild subcutaneous fibrosis. The underlying muscles were not affected. Figure 19, on the other hand, illustrates the late surface effects of a skin dose of 5,000 r in seven weeks with 1,000-kv x-rays. This large dose was given because of the requirements of the tumor. The early erythema was very mild. Three years later there was dense fibrosis of the subcutaneous tissues and rectus muscles, which secondarily retracted the skin and produced pigment disturbances. The irradiated abdominal wall was hard and unresilient. Posteriorly this deep fibrosis often immobilizes the spinal column. Thus, the *late* skin and subcutaneous changes from supervoltage are often worse than those from 200-kv.

In 10 per cent of the patients who received 5,000 r or more, in fifty to seventy-five days, to the lower spinal cord or cauda equina, there was damage of the motor fibers.

Of approximately 200 patients with tumors of the testis whose spinal columns received calculated tissue doses of approximately 5,000 r, 3 (1.5 per cent) had radiation-induced osteogenic sarcoma. Just as automobile accidents from modern

high-speed cars are far more devastating than those of three decades ago, so radical roentgen therapy undertaken to destroy deep-seated radioresistant cancer with heavy dosage can cause serious injuries unless carefully and expertly administered.

Let us examine the stomach and intes-



Fig. 19. Appearance of skin several years after a skin dose of 5,000 r in seven weeks with 1,000-kv x-rays. The primary erythema was very mild. The severe late effects are due to progressive dense fibrosis of subcutaneous tissue and underlying muscles, which form a hard board-like mass. The skin is retracted into this fibrous mass with resultant pigmentary changes. Although the early effects of supervoltage x-rays are mild, the later effects can be severe because of the depth of the biologic effect of the irradiation.

tines traversed by beams of supervoltage radiation in quantity sufficient to deliver tissue doses of 4,000 to 5,000 r in fifty to seventy-five days.

Various types of damage occurred to the stomach (Fig. 20). Radiation dyspepsia consisted of gastric distress without objective findings. Radiation gastritis was attended by contracture of the antrum due to dense submucosal fibrosis. Radiation ulcer and perforation of the ulcer also occurred. The severity of the damage was related to the dose. At each dose level, however, a certain number of patients escaped injury. For example, with tissue doses to the stomach of 5,500 to 6,400 r, 37 per cent of the patients escaped injury (Fig. 20). This illustrates the degree of calculated risk one accepts when under-

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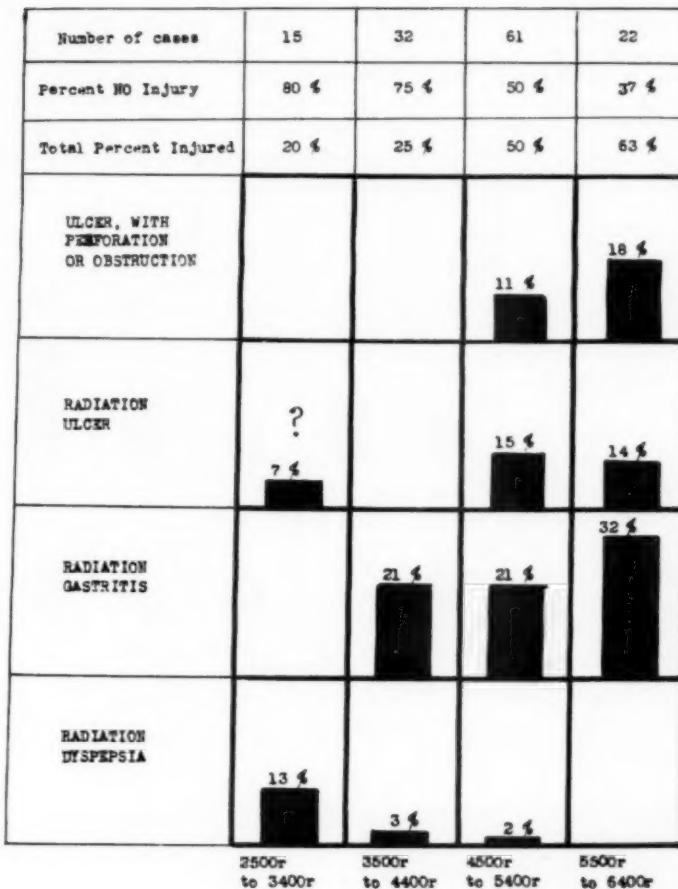


Fig. 20. Types of injury of the stomach produced by different tissue doses during the course of irradiation of the retroperitoneal nodes in a group of 130 cases of tumors of the testis. The higher the tissue dose, the greater is the percentage incidence of injury, and the more severe is the nature of the injury. The peptic ulcer (incidence 7 per cent) in patients who received the smallest dose was probably not caused by the irradiation. This chart is useful in evaluating the degree of calculated risk of injury to be undertaken when one irradiates advanced cancer. With improved techniques, such as supervoltage rotation, the above injuries have been almost completely eliminated.

taking to destroy some radioresistant cancers. The risk is warranted when no other hope of cure exists. At the more common dose levels of 3,500 to 4,400 r, only 25 per cent of stomachs are injured; at 4,500 to 5,500 r, the chances of injury are 50 per cent.

Similar changes can occur in the transverse colon (Fig. 21), though this organ can tolerate larger doses (approximately 1,000 r more) than the stomach. The rectum is still more resistant to radiation and can

tolerate tissue doses up to 8,000 r or more without serious damage. Reasonably safe doses, rarely producing injury, are shown in Table III.

Can we circumvent these injuries? Multiple portals with 200 kv as well as supervoltage radiation will reduce the damage, especially to organs somewhat remote from the tumor area. The rotation technique with supervoltage irradiation is a decided advance. Unless rotation is employed, only a small part of the potential

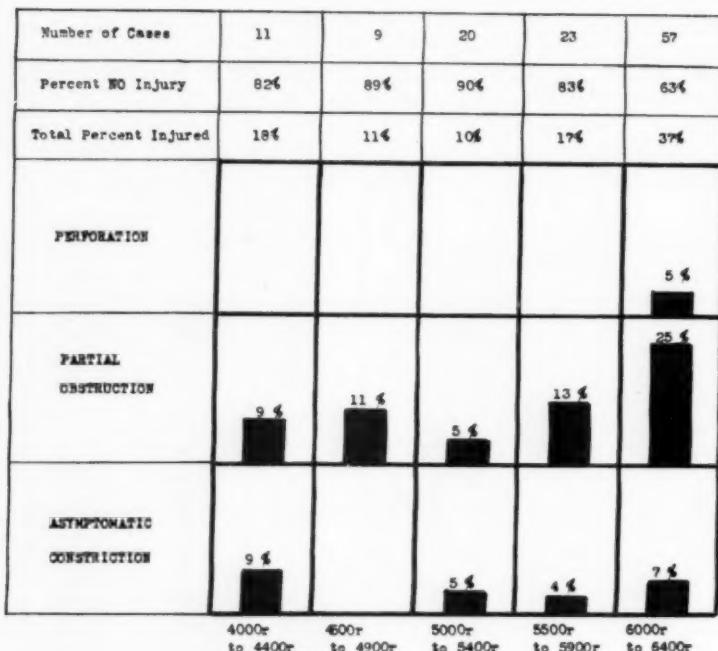


Fig. 21. Type and incidence of injury to the transverse colon during irradiation of retroperitoneal nodes for carcinoma of the testis. The percentage incidence of injury, as well as the degree of injury, is proportional to the tissue dose. In general, the transverse colon is more radioresistant than the stomach and requires larger doses for the production of injury.

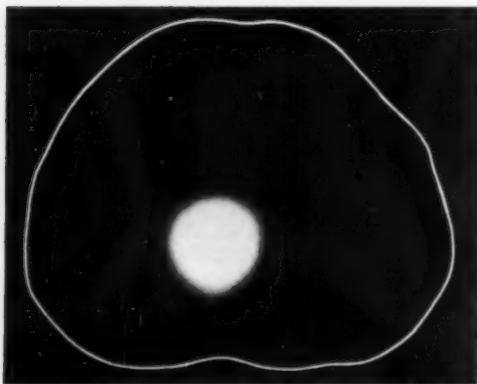


Fig. 22. Distribution of radiation in the abdomen with supervoltage rotation therapy of retroperitoneal nodes. The amounts of radiation delivered to the normal tissues are far below the tolerance level. The largest safe dose delivered to date by the above technic was 6,300 r in six weeks to the retroperitoneal nodes. There were no sequelae.

advantage of supervoltage is utilized. Currently, using 2,000-kv x-rays from a resonant transformer generator and a

TABLE III: TOLERANCE DOSES OF NORMAL TISSUES

Organ	Tissue Dose (r)	Overall Time (weeks)
Stomach	3,500	5-9
Transverse colon	4,500	5-9
Central nervous system	5,000	5-9
Small intestine	4,200	5-9
Rectum	8,000	5-9
Kidneys (part of each)	5,000	5-9
Kidneys (all of both)	2,500	3-6

target-axis distance of 125 cm., which permits sharp collimation of the beam with a minimal penumbra, we are able to deliver to the retroperitoneal nodes tumor doses up to 6,300 r in six weeks without evidence of late radiation effects, because the dose to the surrounding normal structures is small (Fig. 22).

What has been achieved in this series of radioresistant tumors (trophocarcinoma and teratocarcinoma)? The previous five-year arrest rate ranged from 10 to 15

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TABLE IV: FIVE-YEAR ARRESTS IN RADIRESISTANT NON-SEMINOMATOUS TUMORS, TREATED BY RADICAL NODE RESECTION PLUS SUPERVOLTAGE IRRADIATION

Stage of Disease	Five-Year Arrest (%)
No metastatic nodes demonstrated surgically.....	69
A few small nodes.....	46
Large nodes or distant metastasis.....	2
TOTAL	39

per cent when no metastatic nodes were demonstrable clinically. Now, with the aid of radical resection of the retroperitoneal nodes and supervoltage irradiation the results are as shown in Table IV.

It was with the early, ignorant, and erroneous administration of supervoltage irradiation that many serious and fatal injuries were produced. Now, with improved technic, these rarely occur by accident. Only with an advanced radioresistant tumor do we take calculated risks, which are sometimes justified by arrest of the tumor. As a result, the five-year-arrest rate for non-seminomatous radioresistant testicular cancer has been considerably

increased. Although part of this achievement is due to radical surgery, supervoltage irradiation has contributed materially.

SUMMARY

Supervoltage irradiation arrests certain tumors which might not otherwise be successfully irradiated. The frequency of this accomplishment is not large. The arrest rate of some radiocurable tumors is enhanced. Radiosensitive tumors such as seminoma, when widely disseminated and rapidly growing, can be overtaken and eradicated. Radioresistant tumors, like trophocarcinoma and teratocarcinoma, can be given the necessary large tumor doses when deeply situated.

Without the protective guidance of the skin erythema the unwary radiotherapist may deliver dangerously large doses of radiation to the interior and cause serious or fatal damage to normal structures.

To realize the potential advantages and avoid the pitfalls of supervoltage irradiation, experience and training are required.

1067 Fifth Ave.
New York 28, N. Y.

The Treatment of Inoperable Carcinoma of the Breast with Conventional 250-kv Irradiation as Compared with 2-mv Irradiation¹

RUTH J. GUTTMANN, M.D.

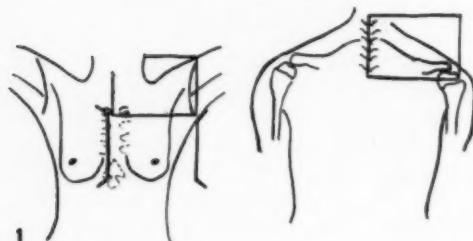
An attempt is being made to compare conventional roentgen therapy—its possible advantages or disadvantages—with supervoltage irradiation. In order to reach as objective an opinion as possible, this problem has been evaluated by outlining the management and course of one disease which was treated in the Radiotherapy Department of the Francis Delafield Hospital, New York, with conventional therapy at one time and supervoltage therapy at another time. The other treatment factors—including the patient material—have remained essentially un-

changed. Since most deep-seated tumors have received supervoltage irradiation, there was only one large group of patients which met the above requirements, namely, those with inoperable carcinoma of the breast.

Since the Francis Delafield Hospital opened five years ago, we have had the opportunity of treating a relatively large group of patients with inoperable breast carcinoma. The reason for the large and unexpected number of patients with carcinoma of the breast classified as inoperable has been the adoption of new criteria for operability by Dr. Haagensen, adding

¹ From the Francis Delafield Hospital, Columbia University College of Physicians and Surgeons, New York, N. Y. This work was supported in part by a grant from the National Cancer Institute of the National Institutes of Health, U. S. Public Health Service.

FIELD ARRANGEMENT 250 KV UNIT



TANGENTIAL BREAST APPROACH
INCLUDING INTERNAL MAMMARY AREA
250 KV UNIT

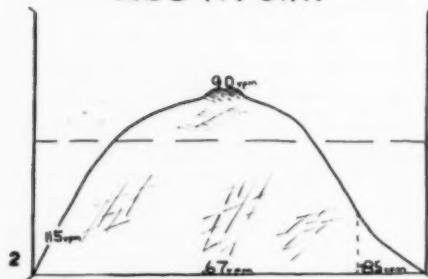


Fig. 1. Outline of fields for 250-kv irradiation.

Fig. 2. Dosage distribution to the breast, including internal mammary area, when 250-kv irradiation is used exclusively.

to the old criteria originally outlined by Haagensen and Stout. As a result of this change of policy, 40 per cent of the patients with primary carcinoma of the breast seen in our hospital are declared inoperable.

A lesion now is considered inoperable if a triple biopsy—*i.e.*, a biopsy of the tumor itself, of the highest axillary node, and of the internal mammary nodes—shows disease in any of the lymph nodes, despite the fact that the primary tumor may be small.

Thus, in this hospital, inoperability does not imply the technical impossibility of performing radical surgery. Instead, it indicates the inadvisability of operation, in that the disease probably extends beyond the limits of surgical approach. For technical reasons, we have treated patients in three different ways: with conventional

250-kv irradiation, with combined conventional and supervoltage irradiation, and with supervoltage—2-million-volt—irradiation alone. During the last two years we have made it a point to treat all patients with the 2-million-volt unit exclusively.

The use of all these different methods has given us a good chance for comparison. We have treated so far a total of 115 patients with inoperable carcinoma of the breast: 21 with 250-kv irradiation alone, 46 with combined 250-kv and 2-million-volt irradiation, and 48 with 2-million-volt irradiation exclusively.

The time which has elapsed is too short for the submission of any results. In a disease which runs so varied a natural course as carcinoma of the breast, many years must pass before evaluation becomes possible. However, the number of cases treated is sufficient, and the observations have been consistent enough, to permit an opinion as to the difference in reactions during, immediately after, and at least one year following completion of radiotherapy.

First, I would like to discuss the group of patients who were treated at 250-kv. With a target-skin distance of 50 cm. and a h.v.l. of 3 mm. Cu we delivered a dose similar to the one suggested by McWhirter, namely, a tissue dose of 3,750 r in three and one-half weeks throughout the breast, including the internal mammary area and the supra- and infraclavicular area, as well as the axilla. In contrast to McWhirter's practice, however, a simple mastectomy was performed in only a few patients who were selected with great care. It is the feeling in our Surgical Department that it is not advisable to cut through obvious tumor or tumor extension, and we have therefore treated the majority of patients through the intact breast. Four fields were used: two tangential breast ports including the internal mammary area, and two more opposing ports covering the supra- and infraclavicular regions and, of course, the axilla (Fig. 1). The size of the average anterior and posterior supra- and infracla-

vicular fields covering the axilla was about 15×18 cm., while the breast fields measured about 15×15 cm.

Figure 2 shows the combined dosage to the two tangential fields. When 90 r were delivered to the skin of the nipple, the chest wall received 67 r; the internal mammary nodes, which we figured at that time at 3 to 4 cm. depth got a dose of 85 r, while the skin on the lateral and medial aspect of the breast got 115 r. If, therefore, we wanted to give a dose of 3,750 r to the chest wall, the skin over the nipple received a dose of 5,000 r, the internal mammary nodes of this side got 4,550 r, and the maximum skin dose on the medial and lateral aspect of the breast was 6,420 r. The skin dose to the anterior and posterior supra- and infraclavicular fields, including the axilla, was 4,670 r.

In the course of this type of treatment, a moist skin desquamation developed, which reached its height about ten days after completion of therapy (Fig. 3).

In addition to this painful skin reaction, other complaints observed in the majority of cases during therapy were: difficulty in swallowing, a sticking sensation in the esophagus, nausea and vomiting, and finally fatigue. The blood counts of some of the patients, especially those in the older age group, showed definite depression of the white cells and platelets, and we were forced to discontinue treatment in some instances in spite of supportive therapy, including transfusions.

The duration of these symptoms varied from three to five weeks after completion of therapy, with one exception, namely, the skin reaction. In most instances, not until three to four months after completion of irradiation was the moist desquamation healed completely. The late appearance of the healed skin shows atrophic changes, fibrosis, and telangiectasis. Most of the patients in this group have, also, edema and induration of the treated areas, and in some patients we have seen, in addition, edema of the arm. These changes are shown in Figure 4.

The second group of patients was treated

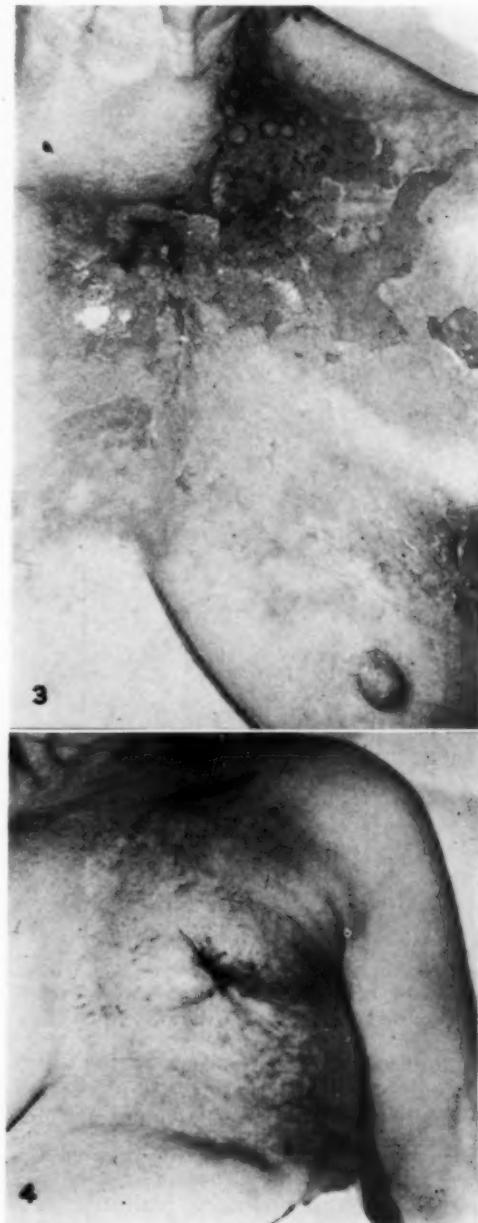


Fig. 3. Moist desquamation occurring just after completion of treatment course, delivered with 250-kv irradiation.

Fig. 4. Late irradiation changes, a year and a half after completion of treatment course on 250-kv unit.

in a combined fashion. At this point we began to treat the areas of lymphatic drainage with the 2-million-volt unit. Here the

FIELD ARRANGEMENT 250 KV & 2 MV UNITS

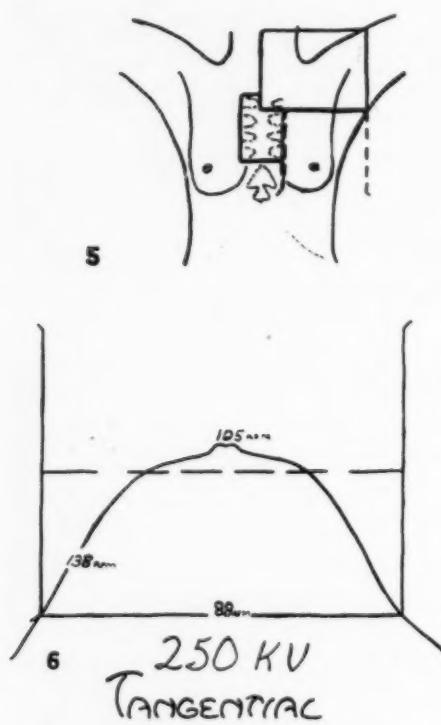


Fig. 5. Outline of fields, for combined 250-kv and 2-mv irradiation.

Fig. 6. Dosage distribution to the breast, showing a slight difference with this approach, where the internal mammary area is treated through a separate field.

factors are: 100 cm. target-skin distance and a h.v.l. of 7 mm. Pb. With this approach we added a separate internal mammary port and were able to treat the supra- and infraclavicular areas, including the axilla, through one large anterior field (Fig. 5). The average size of the internal mammary field is 12 X 8 cm. and of the supra- and infraclavicular fields, including the axilla, 15 X 18 cm. The tangential breast fields were treated as described above on the 250-kv machine, with a field size of 15 X 15 cm. and the other factors as stated.

The tumor dose delivered to the areas which were treated with the 2-million-volt unit was 5,000 r in five weeks, corresponding to a skin dose of 6,000 r for the smaller internal mammary field and 6,125 r to the larger supra- and infraclavicular area (Fig. 6). The dose of maximum ionization when beams of supervoltage range are being used is 0.4 cm. below the skin. However, for simplicity's sake, I shall refer to this dose as "skin dose." The dosage throughout the breast varied from a maximum skin dose of 5,880 r to a minimum tumor dose at the chest wall of 3,750 r. (The slight difference in these figures as compared to those for the first group of patients is due to the fact that the addition of the internal mammary field decreased the separation between ports, and changed the skin dose to the medial and lateral aspect of the breast somewhat.)

The skin reactions in the second group were markedly different from those in the first group. The areas treated at 2 million volts showed only an erythema, beginning in the third or fourth week of treatment and subsequently changing to a tanning and some dry desquamation. The breast itself showed the same moist desquamation as before (Fig. 7).

One year and six months after this combined approach the breast is atrophic, fibrotic and covered with telangiectasis, while the areas treated with the 2-million-volt unit show only a slight tanning (Fig. 8).

Now to the last and third group of patients, who have been treated exclusively by the 2-million-volt unit. Here we have delivered a tumor dose of 5,000 to 5,500 r in five to five and a half weeks through four areas, namely, the supra- and infraclavicular areas, including the axilla, the internal mammary area, and the two tangential breast fields (Fig. 9). The size of the fields was the same as for the second group of patients.

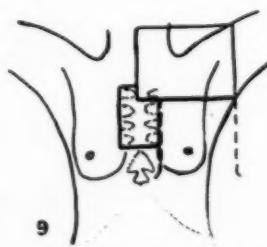
In order to deliver 100 r at 5 cm. depth, where we now figure the dosage for the lymph nodes, it is necessary to deliver a skin dose of 125 to 130 r, according to the



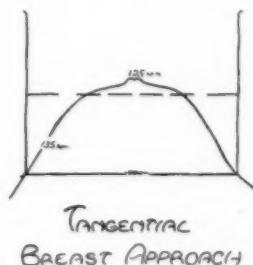
Fig. 7. Photograph of patient treated with combined 250-kv and 2-mv irradiation, showing only a mild reaction in the areas treated at 2 mv but a moist desquamation in the breast which was treated at 250 kv.

Fig. 8. Photograph of same patient, a year and a half after completion of therapy, showing the difference in late irradiation changes, corresponding to the severity of the immediate reaction.

FIELD ARRANGEMENT 2 MV UNIT



9



10

2 MV UNIT

INTERNAL
MAMMARY
AREA

60 mm

80 mm

100 mm

Fig. 9. Outline of fields for 2-mv irradiation exclusively.
Fig. 10. Dosage distribution with 2-mv irradiation exclusively.

size of the field: 125 r to the smaller field covering the internal mammary area, 130 r to the larger field covering the supra- and infraclavicular area and axilla. The breast will receive a dose of 100 r at the chest wall, while the maximum skin dose in the lateral and medial aspect of the breast is 135 r, in other words, a rather even distribution (Fig. 10).

For a total tumor dose of 5,000 r throughout, the skin over the small internal mammary field receives 6,000 r, and

the skin over the larger supra- and infraclavicular field, including the axilla, 6,125 r, while the maximum skin dose to the breast is 6,500 r.

In some of these patients a mild erythema develops during therapy, reaching its peak during the last week of treatment, followed by a dry and sometimes by a moist desquamation. The accompanying photographs demonstrate these different reactions: Figure 11 shows a slight erythema, which was followed by a dry desqua-

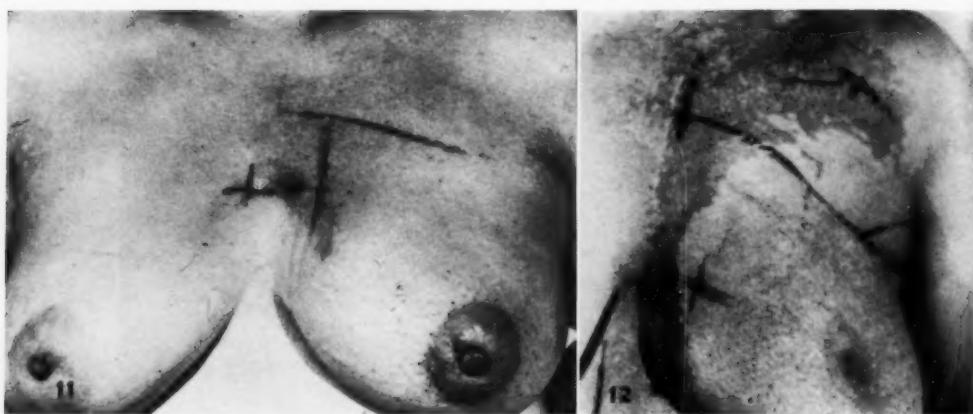


Fig. 11. Photograph of patient at completion of course of 2-mv therapy, showing a slight erythema.
Fig. 12. Dry desquamation following the slight erythema.



Fig. 13. Patient treated in the same way as the one shown in Figs. 11 and 12. This patient, however, has a severe folliculitis.

tion, illustrated in Figure 12. Figure 13 shows a severe folliculitis, and Figures 14 and 15 demonstrate a moist desquamation immediately after completion of therapy,

which looks similar to that shown in Figure 3. There is, however, a very definite difference. While the healing process in patients who were treated with the conventional method was prolonged for three to four months, the same process after 2-million-volt irradiation required only three to four weeks at the most. This has been a constant and definite observation. Figures 16 and 17 show the same patient three weeks later.

As long as one and a half years after therapy, the skin of this last group of patients has remained soft and pliable, with no evidence of atrophy, fibrosis, or telangiectatic changes, as shown in Figure 18.

As to the other symptoms which occur during conventional therapy, 2-million-volt irradiation offers a similar contrast. The mucositis of the esophagus, causing swallowing difficulties, does not appear regularly and, when it does, occurs at a later date, usually not before the fourth week of treatment. Because of the location, it is impossible to determine objectively whether the degree of irritation is less than with conventional treatment.

Changes in the blood count are less frequent. In the few patients, specifically 3, in whom a drop in the white cell and platelet counts occurred, a transfusion permitted us to continue with the course of



Figs. 14 and 15. An even more severe reaction, namely a moist desquamation of the skin.
Figs. 16 and 17. Same patient as in Fig. 14, three weeks later, showing complete healing. See also Fig. 18.

treatment. Finally, nausea and vomiting are reduced to a minimum.

The decrease or absence of all these side-effects is easily explained by the physical differences of 250-kv and 2-million-volt irradiation. The better penetration of supervoltage radiation permits us to deliver a greater tumor dose at greater depth. The maximum absorption does not occur

on the skin but 0.4 cm. below the skin, and skin reactions, therefore, must be less than with conventional therapy. As a result of this combination of a better depth dose and a smaller skin dose, the therapeutic ratio is higher with supervoltage therapy. The rarer occurrence of changes in the blood count is explained by the decrease in bone absorption, and the minimum of general



Fig. 18. One and a half years after completion of the course of 2-mv irradiation there is no evidence of severe radiation changes.

radiation reactions is due to the fact that the integral or volume dose is less than with conventional therapy.

One of the most interesting questions for discussion in contrasting the different methods, and certainly a most vital one, is our observation concerning pneumonitis and pulmonary fibrosis.

The accompanying illustrations will bear out what we have observed constantly in the three groups of patients, namely, that even those who have had no pulmonary symptoms at any time may show certain changes roentgenographically, which are consistent with radiation pneumonitis or radiation fibrosis. Up to now we have not found either clinically or on roentgen examination any difference, regardless of the method by which the patients have been treated.

Figure 19 is a chest film obtained before the beginning of conventional therapy. Except for some deviation of the trachea to the left side, as the result of a mass in the neck, probably within the thyroid, there are no pathological changes. A film of the same patient taken six months after completion of therapy (Fig. 20) shows a homogeneous density throughout the upper lobe, while the tracheal deviation has increased as compared to previous examinations. The rest of the lung fields are clear. Figure 21 shows the appearance twenty-eight months after completion of therapy.

The right hemithorax is noted to be somewhat smaller than the left, and there is a faint hazy opacity, overlying the entire lung field, which may be due to pleural thickening. This patient was treated in June 1953 with conventional 250-kv irradiation. She is well, without evidence of disease, and has never complained of pulmonary symptoms.

Figure 22 is the routine chest film of a patient treated with combined 250-kv and 2-million-volt irradiation. There is no pulmonary involvement. Figure 23, a film taken six months after completion of therapy, shows a dense patchy infiltration, extending outward from the right hilar region to involve the infraclavicular region. There are elevation of the right hilus, and tenting and elevation of the right diaphragm. There is also a suggestion of widening of the hilus. These findings are suggestive of radiation fibrosis. A later film, taken eighteen months after completion of therapy (Fig. 24), does not show any significant change. There is deviation of the tracheal air column to the right, indicating shrinkage and fibrosis in this area. Findings are again compatible with post-irradiation fibrosis. This patient, like the first one, never had any shortness of breath, cough, or other pulmonary symptoms and so far does not exhibit any evidence of recurrent disease.

The last films are those of a patient from the group treated with 2-million-volt irradiation exclusively. Figure 25 is the chest film before start of radiotherapy. In Figure 26, taken six months after completion of radiotherapy, there is not much change.

Figure 27, taken thirty months after completion of irradiation, shows some obliteration of the left costophrenic sinus due to adhesions and some tenting of the left hemidiaphragm as a result of pleural or pericardial or diaphragmatic adhesions. Faint mottled densities in the left infraclavicular region may be due to pleural thickening over this region. These changes are probably attributable to radiation pleuritis. This patient, like the other 2,



Fig. 19. Routine chest film before therapy.

Fig. 20. Same patient six months after completion of 250-kv irradiation, showing radiation changes.

Fig. 21. Same patient twenty-eight months after completion of therapy.

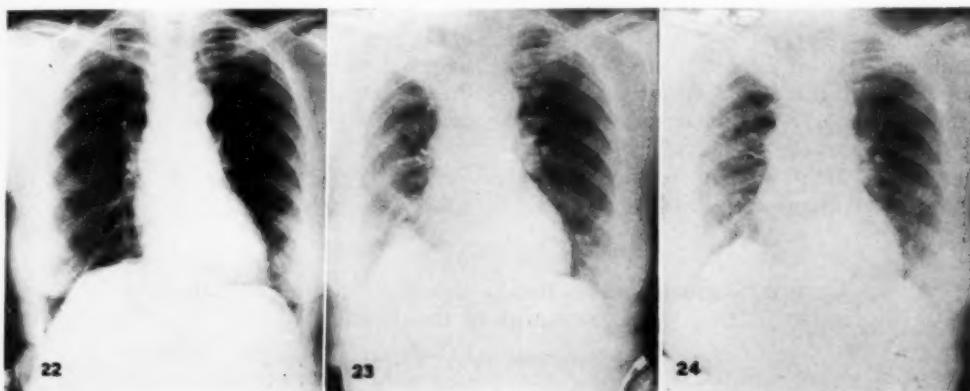


Fig. 22. Routine chest film before therapy.

Fig. 23. Same patient six months after completion of combined 250-kv and 2-mv therapy, showing changes suggestive of radiation fibrosis.

Fig. 24. Same patient eighteen months after completion of therapy.



Fig. 25. Routine chest film before therapy.

Fig. 26. Same patient six months after completion of 2-mv therapy.

Fig. 27. Same patient ten months after completion of therapy, showing adhesions and densities compatible with radiation pleuritis.

has never had any pulmonary symptoms and at present does not show any evidence of disease.

To summarize, too little time has elapsed since we began treating these patients to permit of any conclusions as to the far-reaching superiority of one method over another. It is impossible to say now whether supervoltage therapy does succeed in controlling the disease more effectively or for a greater length of time than does conventional therapy. Even the fact that at autopsy we have found no evidence of disease in formerly positive internal mammary nodes in some patients who were treated with 2-million-volt irradiation is not as yet sufficient evidence on which to base conclusions.

With certainty, however, we have established the immediate advantages of supervoltage therapy. Better general tolerance is clearly demonstrated. Patients treated with the supervoltage unit experienced little nausea and vomiting; blood count depression has been seen only

rarely; immediate skin reactions have been milder, and healing has required a markedly shorter period; within one to two years after completion of therapy no late changes in the skin and underlying tissues are seen; there is no increase in pneumonitis and lung fibrosis. And this, in my opinion, is of utmost importance: to have a weapon in our hands with which we can deliver a high tumor dose throughout the area of involvement and suspected involvement, without imposing upon the patient months of severe discomfort and suffering as a result of the treatment itself, which may or may not sterilize the local disease. In other words, with supervoltage irradiation any result which we may achieve is a net result and a net gain from which we do not have to subtract the uncomfortable weeks during which therapy is given and the months of reaction following the course of treatment.

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Comparison of Conventional and Supervoltage Radiation in Carcinoma of the Bladder

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The following case histories describe the course and ultimate result in 3 cases of cancer of the bladder treated with 400-kv x-rays, cobalt 60 telecurietherapy, and 23 MEV x-rays. All the patients were males in the seventh decade, declared inoperable by the urologist. All are now free from their original disease. Unfortunately, this is not true of the majority of cases of cancer of the bladder thus treated by us.

CASE I: Male, aged 61. Pathological report: poorly differentiated carcinoma of the bladder.

April 26, 1948: Cystoscopy revealed a large, infiltrating carcinoma of the whole left side of the bladder, extending through the bladder wall.

April 29-June 2, 1948: 400-kv external irradiation was given through five fields—one anterior, two lateral, and two angled posterior fields—each 10

× 10 cm. A tumor dose of 5,000 r was delivered over thirty-five days. During the treatment, the patient had considerable discomfort, with frequency of micturition and burning.

June 15, 1948: Cystoscopy showed severe cystitis and adherent phosphatic debris. Bladder lavage was carried out. Subsequently, the patient's general condition deteriorated and he continued for fifteen months as an invalid, with great frequency of micturition, pyuria, and intractable cystitis.

August 13, 1949: Cystoscopy showed low-grade injection throughout the bladder. There was bullous-like elevation of the mucosa over the left half.

April 4, 1950: Cystoscopy revealed a small contracted bladder, with considerable bullous edema in the posterior wall.

Sept. 13, 1950: Cystoscopy showed a scarred bladder with patchy areas of vascularity. The capacity of the bladder was 2 1/2 ounces.

No further cystoscopies have been done on this patient, but the bladder capacity has decreased in

¹ Director of Cancer Services, Saskatchewan, Canada.

amount and now is only 1 1/2 ounces. His general condition has been good for the last four years, but he has had continuous urinary diurnal frequency (every half-hour to one hour) and nocturia (three to six times). He was last seen on Sept. 6, 1955, when his condition was unchanged.

CASE II: Male, aged 65. Pathological report: squamous-cell carcinoma, Grade III, of bladder.

June 4, 1948: Permanent radon seed implantation in an infiltrating tumor, 2 cm. in diameter, in the base of the bladder just above the trigone. The implant was single plane with a dose at 0.5 cm. of 5,500 r.

Nov. 8, 1949: Cystoscopy showed gross recurrence of tumor, extending from the left of the mid-line, backward and laterally.

March 17-April 4, 1950: 23 MEV x-ray treat-

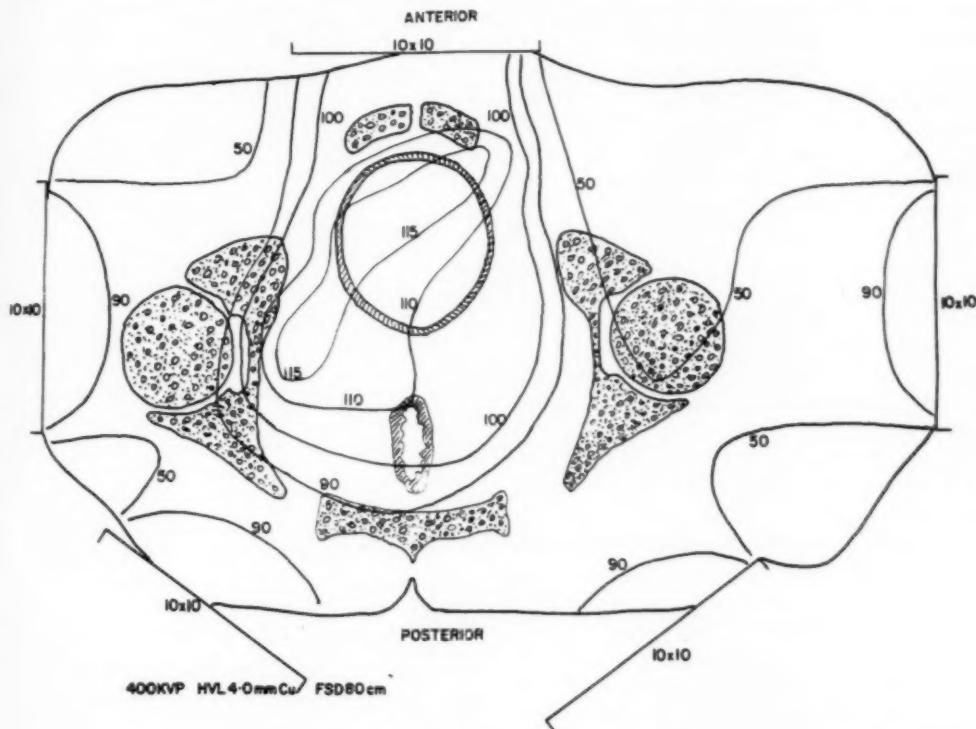


Fig. 1. Isodose distribution for 400-kvp irradiation.

June 3, 1953: Cystoscopy showed a solid mass on the right bladder floor between the right ureteral orifice and vesical neck, about 2 cm. in diameter.

June 16-July 4, 1953: Cobalt radiation was administered, with conical rotation, both from the front and back, the size of field at the tumor being 8.4×8.4 cm. Fifteen daily treatments were given, the tumor dose being 5,500 r over a nineteen-day period. There was no reaction to the treatment, apart from intermittent burning on micturition for one month; no diarrhea and no skin reaction.

The patient has had no complaints since that time and repeated cystoscopy has been negative. The last cystoscopy was performed on Aug. 24, 1955.

CASE III: Male, aged 67. Pathological report: transitional-cell carcinoma, Grade II, of the bladder.

ment to the bladder (betatron). Four fields were used: one anterior and one posterior, each 15×10 cm., and two lateral fields, 10×8 cm. The tumor dose was 6,600 r and the number of treatment days was fourteen, over a twenty-day period. Two fields only were treated each day. The patient exhibited no constitutional effects until the end of treatment, when diarrhea developed, lasting for two days. There was no urinary upset, and no skin reaction.

Cystoscopy has been done regularly following treatment, the last time being May 24, 1955. The bladder has remained normal. There are no urinary symptoms and the general condition is good.

Some of the salient points from these case histories are summarized in Tables I and

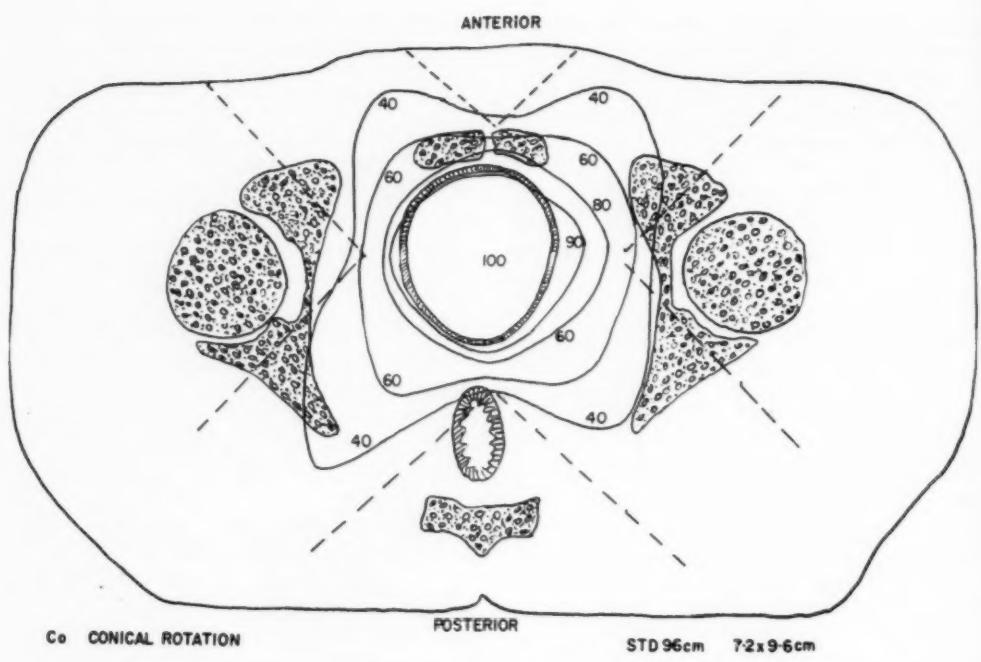


Fig. 2. Isodose distribution for cobalt conical rotation therapy.

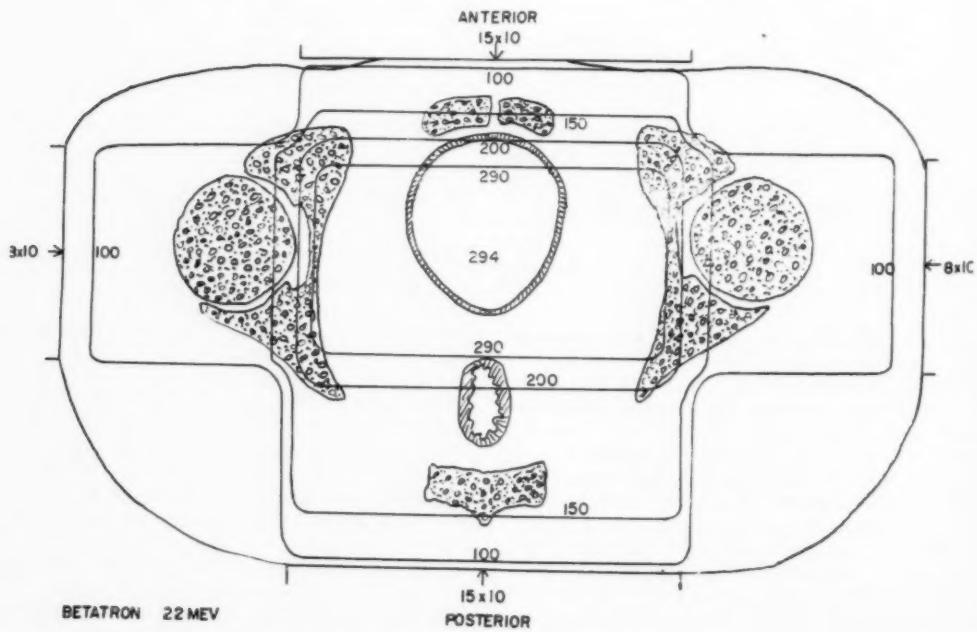


Fig. 3. Isodose distribution for 22-MEV betatron.

TABLE I: THREE CASES OF CARCINOMA OF THE BLADDER

	Case I	Case II	Case III
Pathology	Anaplastic carcinoma	Squamous carcinoma, Grade III	Transitional-cell carcinoma, Grade II
Type of treatment	400 kv	Co ⁶⁰ (rotation)	23 MEV
Tumor dose	5,000 r/35 days	5,500 r/19 days	6,600 r/20 days
Reaction	Very severe	Very mild	Mild
Result	Well 7 years. Contracted bladder.	Well 2 years	Well 5 years

TABLE II: COMPARISON OF TECHNIQUES IN THREE CASES OF CARCINOMA OF THE BLADDER

	Case I (400 kv)	Case II (Co ⁶⁰)	Case III (23 MEV)
Integral dose	High	Low	Low
Skin-tumor ratio	1:1	1:5	1:3.5
Tumor dose (normalized for 35 days)	5,000 r	6,000 r	7,200 r
Dose to bone	High	Low	Low
Treatment plan	Complex	Simple	Simple

II. It will be seen that all the tumors were of a fairly high grade of malignancy. This usually predisposes to spread outside the pelvis, but in these cases apparently complete resolution was obtained by irradiation confined to the pelvis, indicating that distant spread had not taken place. The doses were what we consider to be near tolerance in 2 cases; in the patient treated with 400 kv, tolerance was exceeded. These tumor doses are normalized in Table II to an overall period of 35 days for comparison. It will be seen that the doses given with Co⁶⁰ and 23 MEV are respectively 20 per cent and 44 per cent higher

than that given with 400 kv. On the other hand, the volume irradiated with 400 kv was larger, and the integral dose larger, than with either Co⁶⁰ or 23 MEV.

The isodose distributions (Figs. 1-3) demonstrate that with supervoltage much more homogeneous irradiation can be obtained around the site of the tumor, with only trifling doses to the skin. Skin reactions are thus eliminated, and, because the high dose area is more sharply localized, irradiation of nearby bone is reduced. The fact that, with supervoltage radiation, bone absorption is proportionately less also reduces the danger of bone necrosis. The complexity of the arrangement of fields necessary with 400-kv radiation is much greater than with supervoltage therapy. Because of the distribution of the x-rays in the tissues, it is much easier to localize the high dose volume to the tumor and its immediate vicinity with supervoltage than with conventional x-ray therapy.

To summarize, the patients treated with supervoltage were more comfortable during and after treatment, skin reactions were non-existent, and the ultimate result was far better (perhaps this was because we were traveling only about 75 miles an hour). Considerably simpler treatment field layouts are possible with the higher voltage. In our experience, advanced cases of cancer of the bladder have responded poorly to conventional x-ray therapy. A marked improvement has taken place with the advent of supervoltage irradiation.

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Discussion

Following the reading of the foregoing papers, Dr. Carpenter, the Moderator, called upon each of the Panelists in turn to comment on the presentations of his colleagues.

Dr. Cantril: In his first case presentation Dr. Friedman demonstrated the use of supervoltage rotational therapy in carcinoma of the tongue in a patient who had been treated by irradiation for

two other oral cancers. The procedure was expertly done and apparently accomplished the desired result. I ask, however, if in such a case interstitial radium might not be simpler and as effective, but perhaps less of a mathematical exercise for the physicist and physician.

Supervoltage therapy has, I think, one of its major advantages in the treatment of testicular tumors. Here one receives what I like to call the

dividends of supervoltage, in the form of the lesser constitutional effects which come from the factor of the integral dose. The patient supports the treatment better from the standpoint of general constitutional signs. Here again I would not wish to imply that conventional radiation could not be used, though with somewhat greater discomfort to the patient and difficulty on the part of the therapist.

Concerning supervoltage therapy in carcinoma of the testis—or any other carcinoma—I think Dr. Friedman's remarks in his initial introduction were pertinent, namely that, if one is driving a Ford, one is cautious; if one is driving a Cadillac, he can increase his speed by the factor of 2. I think, however, the patrolman would call this reckless driving.

From the standpoint of long-term results, it has been our experience over some eighteen years that our protraction now becomes greater and greater as the voltage goes up and that one cannot force cures by increase of dose alone.

Dr. Guttmann's comparison of conventional and supervoltage therapy in carcinoma of the breast is well stated. It shows the lesser morbidity associated with supervoltage therapy when properly used. From the standpoint of carcinoma of the breast I do not feel that in advanced cases one would have any greater salvage with supervoltage than with conventional irradiation but, as was pointed out, the morbidity is certainly less.

Dr. Watson's cases well demonstrate the possibilities of supervoltage both from the standpoint of the depth patterns and the avoidance of damage to important structures in the treatment of deep-seated tumors. I think this well illustrates the usefulness of supervoltage, and I emphasize, *in selected cases*.

Dr. Friedman: Dr. Cantril's first patient had necrosis of bone. According to all physical calibrations and the statements of the physicists we are not supposed to have necrosis of bone with supervoltage radiation. They have demonstrated unquestionably that the bone dose is materially reduced with supervoltage as compared with conventional irradiation.

My experience has been that there has been no decrease in the incidence of bone necrosis with supervoltage radiation. This statement, however, must be made very tentatively. In order to demonstrate this point clearly, one way or the other, one would need three or four hundred cases, but at least our early experience points in that direction.

Dr. Guttmann has remarked that possibly some radiation injuries came about because of the high daily tumor dose. She says that their average daily tumor dose is 200 r. In treating testicular tumors, our average daily tumor dose was 100 r, and the total tumor dose of 5,000 r was delivered

in most instances over a period of fifty to sixty or in some cases seventy days. The injuries that come from supervoltage are due predominantly to fibrosis. It is my impression that, whereas the destructive changes in tumor or normal tissues are intimately related to a time schedule, the effect on the connective tissue is less dependent upon that factor.

When we first reported these radiation injuries, some severe criticism was delivered in our direction. We are now hearing that many people—or at least some people—in spite of the knowledge of our experiences, are beginning to encounter these radiation injuries of the gastrointestinal tract not only here but also in England.

Concerning Dr. Watson's statement with respect to carcinoma of the bladder, namely, that he is driving at the rate of only about 75 miles an hour, implying that he employs a smaller tumor dose in these cases, we have treated to date about 60 carcinomas of the bladder with supervoltage rotation therapy and find that if you continue to use the tumor doses of 6,000 or 7,000 or 7,200 r, the salvage in the advanced cases, which is small to begin with, will be even smaller. We have had a significant number of recurrences of bladder cancer after tumor doses of 8,000, 9,000, and 10,000 r delivered over a period of forty to fifty days with 2,000,000-volt rotation therapy.

Dr. Guttmann: I would like to say a few words about the incidence of bone necrosis where treatment at 2,000,000 volts, or supervoltage therapy, is being given. I believe that such necrosis will be observed where the bone was involved by the disease *before* irradiation was undertaken but that it occurs much less frequently if the bone was intact at the beginning of treatment. Otherwise, I do not think that I have much to add to what Dr. Cantril and Dr. Friedman have said. I believe the lack of fibrosis and skin changes observed by us over a period of five years may be due to a difference between one- and two-million-volt irradiation if there is no difference in the daily dosage.

Dr. Watson: I have little to add except to support Dr. Friedman in his statement about bony necrosis. We all tend to believe the physicists when they say that the absorption of supervoltage radiation by the bone will be perhaps a fifth or a third as great as at 200 kv, but the only fracture of the neck of the femur that we have had was produced by 23 million volts.

At this point questions were collected from the audience and assigned by the moderator to individual panelists for discussion.

Question: My 250-kv machine is not paid for yet. Should we mortgage ourselves to keep up with the Friedmans?

Dr. Cantril: This might be called a \$64,000 question, since that sum represents about the

middle range for purchase of supervoltage equipment or cobalt 60. I would advise the questioner certainly to keep his 250-kv machine; keep it long enough at least to have paid for it and learned how to use it and then keep it for a number of years to ascertain what the results are. Then he can come back to this meeting ten years or more from now and see if the claim for supervoltage is still as high.

Question: After at least eighteen months experience, has Dr. Guttmann noticed any difference in the proportion of distant metastases in the two series of carcinoma of the breast treated at 250 kv and at 2 MEV?

Dr. Guttmann: We have not gone over our patient material from this angle. As we may see more of the patients coming back who have not done so well, I think it would be a fallacy just to make a statement on the spot.

Question: What types of lesions would not do better with supervoltage? Are there any lesions where conventional therapy is preferable?

Dr. Friedman: It is my clinical impression that the quality of radiation delivered by 200 kv is much closer to the optimum efficient relative biological effect than supervoltage radiation. This principle was rather clearly defined yesterday in Dr. Failla's discussion of one of the papers on relative biological effect.¹

In my own experience, there is no improvement in results in carcinoma of the larynx with the use of supervoltage radiation. If you have a superficial lesion as in the first case I showed—a superficial metastatic neck node—and are going to deliver all the irradiation through one portal, assuming that you are going to use an aggressive radiation technic because the lesion is resistant, and aim to deliver a skin dose of 7,000 or 8,000 r measured with scattering, you are safer with 200 kv than with supervoltage. With the lower voltage you have a third-degree skin reaction, but it will heal in almost every instance and the residual fibrosis will be about a centimeter thick, whereas with an equal dose of supervoltage radiation, through a single portal, you will have a much milder early reaction but an increased likelihood of a craterous ulceration of skin, subcutaneous tissue, and muscle occurring after a lapse of months or years.

Question: Can a busy general practitioner of radiology do better or as well with supervoltage than with "ordinary" conventional equipment? Can he do worse?

Dr. Watson: I think undoubtedly a radiologist could do better in many cases with supervoltage equipment than with conventional x-ray equipment. This is apparent when one considers the great bulk of cases which we in the past were

treating at 200 or 400 kv and realizes that more than half of these are now being treated with supervoltage x-rays. The cost, of course, is greater, but some of us think that a little increased benefit to the patient can be obtained and that this should not be outweighed by any consideration of expense.

Question: Inasmuch as your studies (Dr. Cantril) have repeatedly shown that cancer cells remain after irradiation of breast cancer, why do you continue to treat it? If you believe radiation is of value, what effect does it have on the cancer cells or normal tissues to account for the improved (?) survival figures?

Dr. Cantril: The patients with carcinoma of the breast whom we treat are those in whom we are attempting to retard the growth of the lesion. I do not feel that we have in any significant number of patients controlled the regional disease in advanced breast carcinomas. By and large, our use of radiation in any form of carcinoma of the breast is for palliation, whether directed to the primary lesion or its metastases.

Question: Are we not limited by the danger of irreparable damage to normal tissue and vital organs even with rotational supervoltage therapy?

Dr. Friedman: To begin with, with conventional therapy in a small number of instances we cannot undertake to cure certain lesions that we could cure with supervoltage irradiation. In those instances, therefore, we would refrain from using 200 kv and would use supervoltage irradiation. If we use supervoltage radiation, there is a calculated risk of producing serious damage to normal tissues. This risk is reduced if we rotate with supervoltage irradiation.

Question: Do you believe that there is a biological difference between 250 and 1000 kv in ability to produce fibrosis?

Dr. Friedman: I do not think there is a biological difference in ability to produce fibrosis, but the greater dose delivered to vulnerable tissues, such as muscle and loose connective tissue, and to vital organs, at supervoltages is responsible for the difference.

Question: In treating the breast with 2-million-volt therapy, are you not concerned with the fact that the skin dose is low in comparison to the depth dose? If there is skin involvement, will you not be under-treating the skin?

Dr. Guttmann: The dosage throughout is 6,000 to 6,500 r. This is the same dose as delivered when we are treating with conventional therapy. We have not seen a great incidence of skin recurrences. I would say the percentage of skin recurrences in a patient treated at 250 kv and that following treatment with 2,000,000 volts is about identical.

¹ To be published.

Question: Why is simple mastectomy not done prior to early irradiation?

Dr. Guttmann: I do not want to go into details which do not belong to the discussion. It is the feeling in our surgical department that patients do worse when obvious tumor (?) is being cut through.

Question: What caused the death of the patient in whom the internal mammary glands were controlled as noted at autopsy?

Dr. Guttmann: I did not mention that in a high percentage of patients on whom we did bone marrow aspirations or biopsies from the vertebrae, in order to determine whether the disease had spread to other areas, there was evidence of bone involvement at the time treatment was begun. I do not recall whether this patient died from liver metastases or from generalized metastases.

Question: What is the relative importance of dose, per se, compared with so-called "biological predeterminism" in the radiation curability of cancer?

Dr. Watson: I think the dose must always be of some importance. If you are convinced that you are not going to cure the patient or do him any good with any dose, simply because of the biological predeterminism, you might as well not treat him at all.

Question: In a recurrence after 200 kv, would you repeat irradiation with rotation 1,000 kv?

Dr. Watson: I think if you determined to repeat a treatment in the case of recurrence the skin might be a limiting factor. In that event, supervoltage radiation would seem to offer some advantage in that the possibility of subsequent necrosis is less.

Question: In Dr. Cantril's first mentioned case, why did he use a pile driver to sink a carpet tack? How much more superficial can the disease get?

Dr. Cantril: My confidence in radiation therapy does not permit me to class advanced carcinoma of the alveolar ridge invading the floor of the mouth at its junction with the tongue, and extending through the floor of the mouth, as superficial cancer. I would find it difficult to obtain the dose of radiation which we used through a single portal with conventional therapy, though it could be obtained by the use of multiple fields. In this particular instance I think it was much simpler for the patient, and certainly for us and for the surgeon thereafter, to use what the questioner calls a pile driver.

Question: What is your opinion of the use of electron therapy as compared to x-ray therapy for skin malignancies? Mycosis fungoidea?

Dr. Cantril: I must say at the outset that I have had no experience with electron therapy. I would say that skin cancer can be well treated

by x-rays in the range of 100 to 250 kv, if required.

Mycosis fungoidea is a skin manifestation of a lymphoma which usually involves the deep-seated organs. One can treat the superficial manifestations by any technic; if the deeper manifestations related to the vital organs of the body are not to be avoided, by low-energy electrons?

Question: Is there any advantage in treating over longer periods of time with lower daily doses?

Dr. Cantril: I believe there is an advantage in treating over a longer period of time, whether using conventional or supervoltage irradiation. There is an advantage from the standpoint of being able to observe the patient and from the standpoint of the more gradual reaction of the tumor. I think the incidence of radiation injury will be lower, and I doubt whether the curability will be any less.

Dr. Friedman: The range of tumor dose necessary to eradicate mycosis fungoidea nodules in one patient throughout the entire course of the disease varies enormously—it could be by a factor of seven to one.

Within the next few months there will appear an article in RADIOLoGY on the time-factor in the treatment of multiple mycosis fungoidea nodules.¹ In one of the cases reported the tumor lethal dose ranged from 250 r in one treatment up to 600 r over a period of fifteen days. What I am saying is that many mycosis fungoidea nodules are extremely radiosensitive and can be eradicated with far less than an erythema dose. Therefore it will require many more observations to prove that electron-beam therapy offers unique benefits for mycosis fungoidea.

Question: In your first patient, why did you (Dr. Friedman) give a tumor dose of 9,578 r with rotation supervoltage for the third lesion and how did you measure your dosage exactly?

Dr. Friedman: I have a feeling that one area of extreme usefulness for supervoltage therapy and rotation is in squamous-cell carcinoma of the head and neck. We have treated a wide variety of these lesions, at the same time studying the dose required to produce a second-degree epithelitis. We hope to use this as a clinical biological experiment to contribute to the understanding of the relative biological effect. We find that, to produce mucous membrane reactions comparable to those following 6,000 or 6,500 r with 200-kv radiation, one needs doses with supervoltage rotation of the magnitude of 8,000 or even 10,000 r. Additionally, we found local recurrences after supervoltage rotation doses as high as 10,000 r. In the particular case referred to, we feel in

¹ Friedman and Pearlman: Time-Dose Studies in Irradiation of Mycosis Fungoidea. Radiology 66: 374-378, March 1956.

retrospect that the dose of 9,578 r was excessive, but in the other cases it was not.

How do we measure this dose? By the technic outlined and described by Trump of taking a contour with a precision contour meter and dividing it into twelve segments. We use the percentage depth dose curves that Trump and his group have published. The quality of our radiation and the shape of the isodose curves are exactly the same as used by Trump.

Question: How is radiation myelitis treated?

Dr. Friedman: There is no treatment for radiation myelitis; it is a permanent irreparable damage.

Question: Does radiation nephritis occur in man?

Dr. Friedman: This is an interesting question, and a paper will appear on the subject. The Manchester group treats seminoma by irradiating the whole abdomen with the trunk bridge technic. I believe it is unnecessary to irradiate the whole abdomen, but they deliver the dose to the whole of both kidneys. They found a significant incidence of radiation nephritis with tumor doses of 2,300 r. That is a small dose, but 2,300 r to all of both kidneys will produce serious and occasionally fatal radiation nephritis.

With the technic which we originally employed, we irradiated the medial portion of one or both kidneys. We found no evidence of radiation nephritis, though we did not search as carefully as the Manchester group did. But there were no fatalities and no symptoms to warrant that. We also observed that, in order to knock out kidney tissue histologically, tissue doses of the magnitude of 7,000 r were required. To destroy kidney tissue you need 7,000 r, but if only the medial half of the kidney receives 7,000 r there will be no nephritis and that patient will survive.

Question: Please state the 5-year survival percentage for testicular tumors in which radiation therapy is not given—surgery only.

Dr. Friedman: I cannot give you these figures. Dr. Lloyd Lewis in Washington and I in New York are currently running a series of cases wherein we are using only surgery for the eradication of retroperitoneal nodes. It is an extremely important question to solve because, if we can avoid irradiation of the radioresistant retroperitoneal nodes, we can greatly reduce the morbidity.

Question: In what percentage of your (Dr. Guttmann) breast patients do you get severe pulmonary fibrosis (as you showed)?

Dr. Guttmann: I think we have to distinguish between the film findings and the patient's symptoms. I believe I forgot to mention that none of the 3 patients whose films I showed had

pulmonary symptoms, heart symptoms, or dyspnea at any time. In other words, I think we may have a high incidence of these findings on the films, but that subjective symptoms do not always correspond with the film findings. We are at the present time surveying our patient material in order to find out a little more about fibrosis and pneumonitis, but I do not have the percentage figures ready as yet.

Question: Why did 2-MEV treatment give less radiation pneumonitis? Do your (Dr. Guttmann) cases presented today represent a true incidence?

Dr. Guttmann: I did not want to indicate that 2,000,000-volt radiation gives less pulmonary fibrosis. That the film of the one patient showed less, six months after the beginning of therapy, is a coincidence. I have picked these patients in a way which is hardly scientific. These were patients for whom I had Kodachromes eighteen months ago. Since I wanted to have a complete series, I chose patients for whom I had both Kodachromes and films, in order to have Kodachromes during treatment and after treatment, and chest films before treatment and in all stages of therapy.

Question: What about the comparative value of cobalt 60 and 2,000,000-volt therapy?

Dr. Watson: Cobalt-60 gamma rays and 2,000,000-volt x-rays are similar in almost all physical effects. The main difference lies in the cost of the equipment. Generally 2,000,000-volt therapy equipment is much more expensive than cobalt-60 equipment. The cobalt-60 unit is also much smaller and more easily installed. The only other point of comparison is the treatment load which each can carry. The output from a 2,000,000-volt x-ray machine is much greater than from most cobalt-60 machines; therefore, if a department has so many patients that a great number must be treated per day and only one unit is being bought, a 2,000,000-volt x-ray machine should be chosen.

Some tumors of the neck are more conveniently treated by 250- or 400-kv x-rays. There is another group of patients in whom shielding is required. For instance, for certain tumors in the side of the mouth, perhaps inside the cheek, it is convenient to put some kind of a lead mold inside the mouth which will protect it on one side. In this way one side of the mouth can be treated, while the rest escapes any radiation damage. This cannot be done with supervoltage radiation because the thickness of lead required for shielding is too great.

Question: If a new roentgen therapy department is to be set up and the budget allows for only one superficial machine and one deep-therapy machine, would the recommendation of the panel

before (a) 250 or 400 kv, (b) a 1,000,000- or 2,000,000-volt machine, or (c) cobalt 60?

Dr. Watson: Certainly one superficial machine would be needed. The choice between the remaining three is difficult and I don't think the department should be set up in such a way. Radiation therapy requires a great selection of equipment for various types of therapy, including radium, supervoltage, conventional x-ray, and superficial x-ray, if proper treatment is to be given to each individual case. It would be better to refer patients to a large, properly equipped center rather than set up a small, inferior department as envisaged in the question.

Question: May we have a few words as to the place and relative value of cobalt 60 versus betatron therapy.

Dr. Watson: The rays from the betatron, of course, are producing very different energy from cobalt 60. As far as we know, there is no qualitative biological difference in the effect of the 23-MEV x-rays and any other x-rays. There is, of course, a quantitative difference. The only trouble with the betatron is that it is harder to use because of its size; it is not so mobile. The depth dose is very great, but the dose near the skin is very small. Therefore, it is ideally suited for only very deep tumors.

Furthermore, there is not a large accumulation of experience with the betatron. I think at the present time it should still be considered as an experimental machine and that any curable type of case should still be treated by methods which have been more widely used, as cobalt 60 or 2,000,000 or 3,000,000-volt x-rays.

Dr. Carpender: I think we might get around to the original questions now. I have three questions that I'd like to ask the members of the panel. I will go down the line again but will ask the questions first:

1. What per cent increase in cures do you expect on all your patients with supervoltage?
2. How is your patient load divided between ordinary range voltage and supervoltage?
3. Finally, with the directive that has been set up, answer the original question and be sure you give the right answer. Be practical!

Dr. Cantril: If one takes the whole cabinet of patients who are candidates for irradiation, or who can be candidates for irradiation because one has the full complement of apparatus available, from superficial x-ray to supervoltage up to 2 MEV, I would say, from our experience, that the actual percentage increase in survival is something of the order of 15 per cent.

As to how our particular patient load is divided, I should say that approximately one-third receive

supervoltage therapy and two-thirds are treated at lower energies.

In answer to the last question, should we junk 250 kv, I should say definitely "No." Its long history of use should, I think, be continued and it should be the basis of teaching radiation therapy to younger men. It is economical to the therapist and to the patient even in comparison with the loaded cobalt unit per roentgen.

No therapy machine has safety built into it, but certainly 250 kv can be safer unless one is well grounded in all phases of therapy. I would consider that it still is and should remain the work horse of radiation therapy and that those who undertake the use of supervoltage irradiation should, above all, use caution. Caution may be defined as of two sorts. Sometimes people are cautious by producing no reactions and no results. On the other hand, there is caution well guided by clinical experience, observation of patients, and results.

Dr. Friedman: Percentage increase in expected cures from supervoltage radiation? Ten per cent—and most of these cures will be in specialized lesions rather than a broad increase of 10 per cent in all lesions which we irradiate. For example, I have been treating a series of cases of advanced carcinoma of the cervix with x-rays only. About a third of the patients in this series have been treated with 200- or 250-kv x-rays only and the other two-thirds with supervoltage x-rays only. So far the results are similar. If anything, the number of survivors is greater in the 200- and 250-kv series, tending to suggest that, in this type of experiment, cure depends far more—perhaps almost exclusively—on the radiosensitivity of the lesion than the quality of radiation employed.

How is the patient load divided? For malignant neoplasms, 15 per cent 250 kv and 85 per cent supervoltage radiation. But that is chiefly because we are still, after thirteen years, in an exploratory phase, trying to find special indications for supervoltage irradiation.

In answer to the direct question Should we junk 250-kv x-rays? Decidedly no, for the reason which Dr. Cantril mentioned and for a few additional specific reasons. Take seminoma, for example. The proper use of 200- to 250-kv x-rays in all cases of seminoma should yield a 90 per cent to 85 per cent five-year survival rate. The early skin reactions with 250 kv, though severe, are more easily tolerated than the late skin effects with supervoltage. As far as the effects on bone are concerned, we should be able to demonstrate that there are fewer bone necroses with supervoltage if the physical measurements and predictions are correct, but we haven't been able to. There is undoubtedly some other clinical factor which obtains.

With reference to bladder cancer; among an equal number of cases receiving 2,000,000-volt therapy and intracavitary radium or cobalt, the results with intracavitary radium are superior. In a radiotherapeutic practice where we undertake to treat cancers, we still place considerable faith in radium and I certainly would not junk the 250-kv rays.

Dr. Guttmann: How many more cures we can expect from supervoltage therapy I cannot judge. We have had far-advanced cancer material and this has not permitted me to form an opinion. In addition, the time has been too short.

As to the second question, having a cobalt-60 and a 2,000,000-volt unit, we are treating about two-thirds of our patients with supervoltage.

Do we want to do without a 250-kv unit? I would like to add something to what Dr. Cantril and Dr. Friedman have said, in addition to endorsing their views. The 250-kv unit is very much cheaper; and it is often sufficient when we want to treat with limited intent, for example, for

palliation of pain only. Also, it is possible to treat a patient in bed, which cannot be done with our supervoltage unit.

I believe that a supervoltage unit should be present in any well equipped radiotherapeutic department of a large hospital but I do not think that we should try to do without the 200- or 250-kv unit.

Dr. Watson: In regard to the question of survival, I imagine that the survival rate would be very little improved by supervoltage therapy. However, there are many other factors which enter into consideration, such as less discomfort to the patient, both constitutional and local. The proportion of cases which we will treat with supervoltage radiation compared with conventional radiation, if one excludes all patients treated with radium or with superficial x-rays, would be approximately 70 to 30.

Certainly I do not think that we should junk the 250-kv machines. They have advantages in certain types of cases.

SUMARIO

El Supervoltaje. ¿Debemos Descartar los 250 Kv? Certamen

Tratando de contestar la pregunta de si debe descartarse la irradiación a 250 kv en pro de la terapéutica de supervoltaje, celebróse un certamen en la reunión de diciembre de 1955 de la Sociedad Radiológica de Norte América, en la que cuatro autoridades reconocidas expusieron sus opiniones con casos típicos. Vino luego un debate general, en el que cada expositor comentó las declaraciones de los otros, contestó preguntas de parte del público y por fin presentó sus propias conclusiones.

El Dr. Simeon Cantril comunicó 2 casos, uno de carcinoma de la cavidad bucal y el otro de cáncer del cuello uterino, representando indicaciones para el supervoltaje y el voltaje medio, respectivamente.

El Dr. Milton Friedman discutió la superioridad del supervoltaje en ciertas situaciones, con atención particular al carcinoma oral y al carcinoma del testículo, poniendo en guardia al mismo tiempo contra la posibilidad de lesión irradiatoria a

tejidos normales y sugiriendo medios de evitarla.

La Dra. Ruth Guttmann consideró el tratamiento del carcinoma de la mama. Aunque creyendo que no cabía todavía sacar conclusiones en cuanto a la superioridad destacada de un método comparado con el otro, opinó que ya estaban establecidas las ventajas inmediatas de la terapéutica de supervoltaje en el cáncer mamario.

El Dr. T. A. Watson presentó 3 casos de cáncer de la vejiga tratados con radiación de 400 kv, Co⁶⁰ y 23 MEV, respectivamente, deduciendo que con la irradiación de supervoltaje se ha logrado una mejoría notable en el tratamiento de esta dolencia.

A la pregunta inicial—¿Descartaremos la irradiación a 250 kv?—el jurado se mostró unánime en la negativa. El dictamen general fué que ambas formas de terapéutica poseen sus indicaciones y ventajas.

Lung Expansion Patterns Following Upper Lobe Segmental Resection¹

CAPT. PAUL F. WARE, M.C., U. S. A.² and CAPT. HANS-KARL STAUSS, M.C., U. S. A.³

THE FREQUENCY of segmental resection as a thoracic surgical procedure is increasing, particularly in patients with pulmonary tuberculosis, following prolonged chemotherapy. The incidence of complications in this procedure is higher than in lobar resection, but the increased morbidity generally is of a relatively minor degree. Vigilant postoperative care is essential, however, to prevent progression of a minor complication to one of grave consequences. If serious, residual-space and expansion problems persist, the chief value of the operation, namely, conservation of pulmonary function, is lost. In fact, the patient may conceivably be worse off than if he had been subjected originally to a lobar resection.

Accurate knowledge of the potential space defects and expected re-expansion patterns seemed to us to be of practical importance in facilitating the early postoperative care of patients undergoing segmental resection.

In 1945, Robbins and Hale (1-4), in a carefully documented study, described the roentgen appearance of lobar and segmental collapse as seen in a thorough preoperative radiological evaluation, correlated with subsequent surgical and pathologic findings. Ettinger *et al.* (5) in 1952 published an excellent study of bronchial rearrangement following pulmonary resection for bronchiectasis. Due to the inherent pathology of the cases, their study is devoted mainly to expansion patterns after resection of various diseased portions of the middle lobe, lingula, or either of the lower lobes.

The present investigation is concerned with various types of segmental resection in the upper lobes, for pulmonary tubercu-

losis, and the general pattern of parenchymal re-expansion encountered. No previous studies dealing specifically with spatial readjustment and obliteration of pleural dead space after upper lobe segmental resection have been found.

METHOD OF STUDY

A series of 50 patients undergoing mainly apical, posterior, or apical posterior segmental resection for pulmonary tuberculosis were studied.

The types of resection employed were as follows:

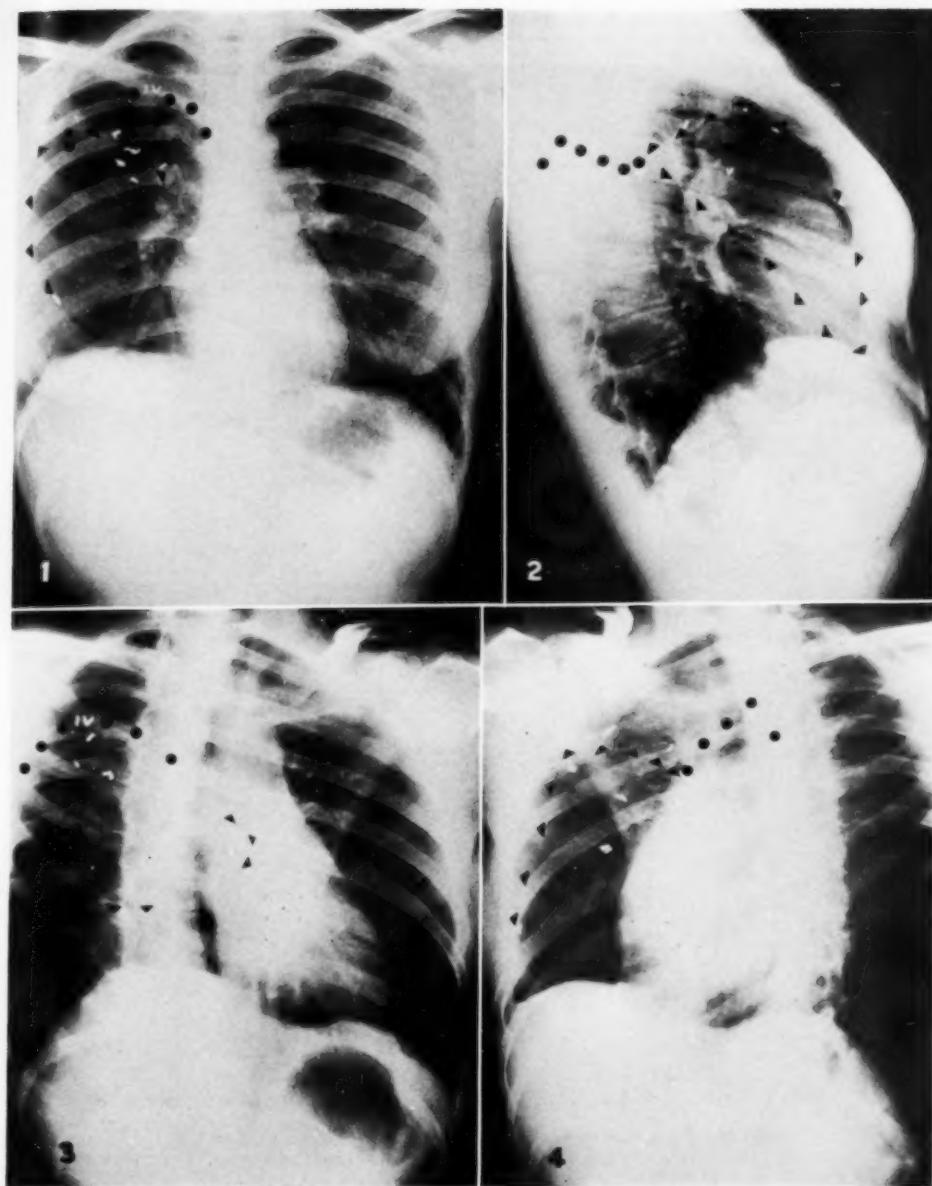
	Number Cases
Right Lung	
Posterior segment.....	6
Apical segment.....	4
Anterior segment.....	1
Apical posterior segment.....	12
Superior segment.....	1
Basal segments.....	2
Right upper lobectomy.....	5
	<u>31</u>
Left Lung	
Posterior segment.....	1
Apical segment.....	4
Apical posterior segment.....	12
Apical posterior and anterior segments.....	1
Lingula.....	1
	<u>19</u>

Following segmental resection, single or double dural clips were applied to the raw pleural edge of the remaining segments. The major fissures or septa were marked with triple dural clips, as was the minor fissure on the right. The apex of the superior segment of either lung, a key point of reference in following re-expansion patterns, was also identified with three dural clips. To clarify the reproductions, dots were placed to outline the superior seg-

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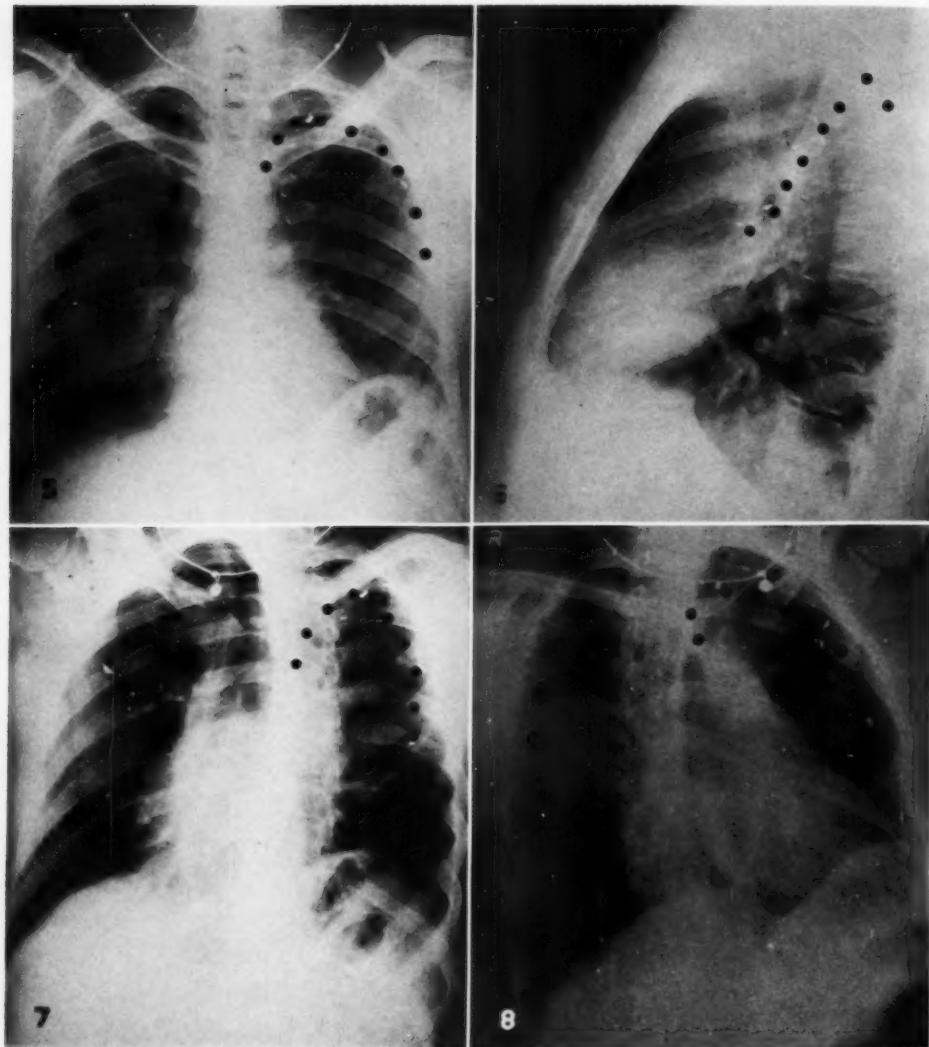
Figs. 1-4. Case I. Posterior Segmental Resection, Right Upper Lobe

Fig. 1. Postero-anterior view. The apex of the superior segment (dots) is in normal position, overlying the fourth posterior rib. The right middle lobe (points) is over-distended, with its upper margin crossing the second anterior rib.

Fig. 2. Right lateral view. The right-lower lobe is unchanged in size and position. The right middle lobe maintains a normal position along the major fissure and in relation to the cardiophrenic sulcus. The superior portion of the right middle lobe, in contact with the anterior segment, is elevated and bulged to the level of the second rib. The relative portion of the right hemithorax occupied by the apical and anterior segments of the right upper lobe is well outlined.

Fig. 3. Right anterior oblique view. The projection of the superior segment in this view is outlined by dots. The mediastinal projection of the right middle lobe is shown by points. The oblique roughly linear defect resulting from posterior segmental resection is seen marked by single and double clips.

Fig. 4. Left anterior oblique view. The area of the right hemithorax, occupied by the remaining apical and anterior segments of the right-upper lobe, is seen in this view above the projection of the superior segments (dots) and right middle lobe (points).



Figs. 5-8. Case II. Posterior Segmental Resection, Left Upper Lobe

Fig. 5. Postero-anterior view. The superior segment of the left lower lobe is very large, with its apex at the level of the third posterior rib.

Fig. 6. Left lateral view. The height of the apex of the superior segment and its relative space occupancy in the left hemithorax are well outlined in this view, as are the unchanged positions of the apical, anterior, and lingular segments.

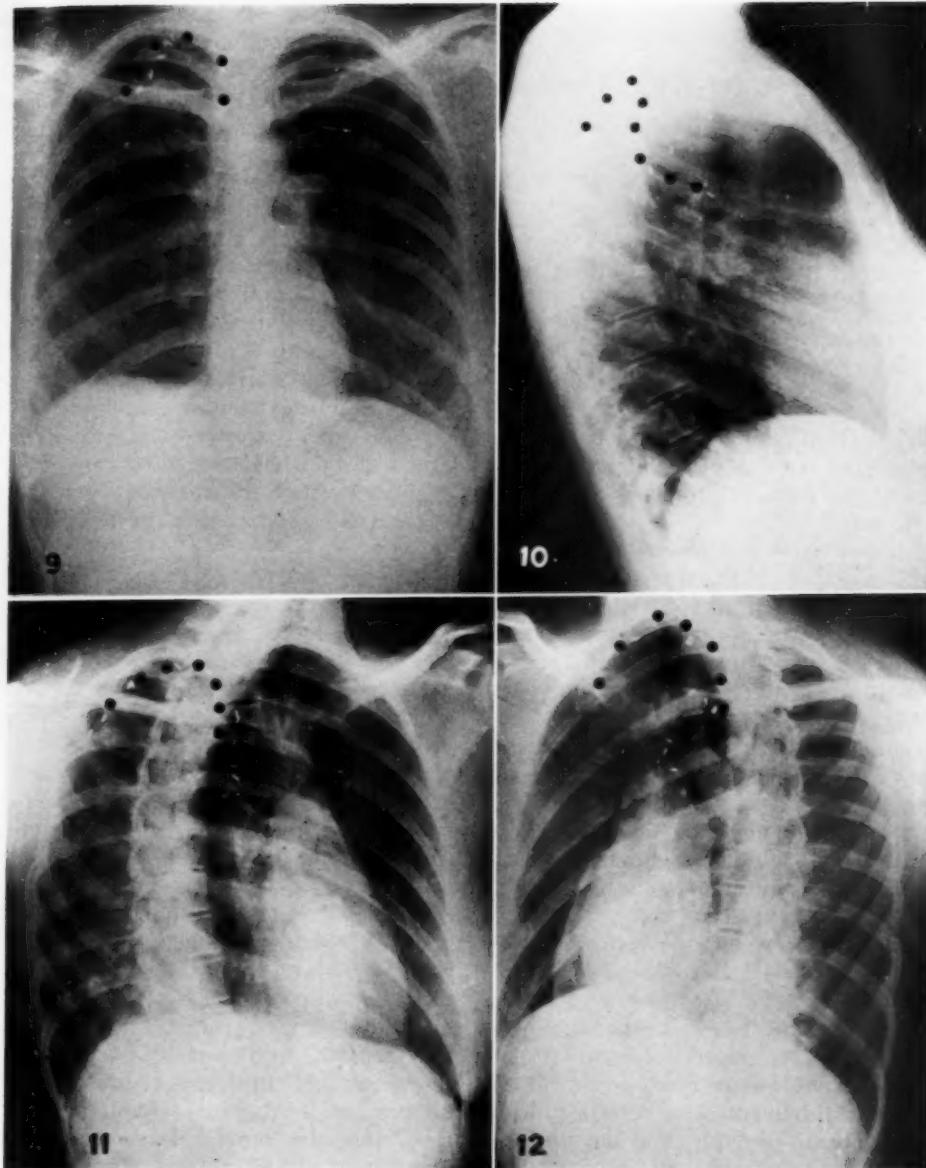
Fig. 7. Left anterior oblique view. The outlined superior segment (dots) is large and performs the major space filling after posterior segmental resection of the left upper lobe.

Fig. 8. Right anterior oblique view. The size of the superior segment is evident, as well as the relatively small amount of space filling performed by the apical and anterior segments.

ment of either lower lobe, and points to define the boundaries of the right middle lobe, using the dural clips as reference marks in the several roentgen views.

The manner of segmental and lobar ex-

pansion and the mechanism of obliteration of the residual segmental defect were evaluated by means of serial radiological observations from the first postoperative day to the sixth month, as follows:



Figs. 9-12. Case III. Apical Segmental Resection, Right Upper Lobe

Fig. 9. Postero-anterior view. The apex of the superior segment reaches just above the third posterior rib.

Fig. 10. Right lateral view. The height of the superior segment in the right hemithorax is outlined by dots. The right middle lobe maintains its customary position. The remaining posterior segment lies between the superior segment and the oblique row of clips marking the area of excision of the apical segment. The anterior segment lies in front of the row of clips, is relatively large and, with the superior segment, does the major space filling.

Fig. 11. Right anterior oblique view. The extent of space occupancy of the extreme right apex by the superior segment is clearly seen.

Fig. 12. Left anterior oblique view. The space filling done by the superior segment relative to the anterior segment is evident.

- First day:* Portable postero-anterior chest film.
Second day: Portable postero-anterior and lateral films.
Fourth day: Portable postero-anterior and lateral films.
Sixth day: Standard postero-anterior, lateral, and right and left anterior oblique films.
End of second week: Postero-anterior, lateral, and right and left anterior oblique films.
End of third week: Postero-anterior, lateral, and right and left anterior oblique films.
Two months postoperative: Postero-anterior, lateral, and right and left anterior oblique films.
Four months postoperative: Postero-anterior, lateral, and right and left anterior oblique films.
Six months postoperative: Postero-anterior, lateral, and right and left anterior oblique films.

Representative cases have been selected to illustrate certain expansion patterns encountered in this group of pulmonary resections.

Posterior Segmental Resection, Right Upper Lobe (Case I, Figs. 1-4): Positional changes by the right middle lobe dominate space filling after posterior segmental resection. Six examples of this resection were studied. In 2 cases shift and overdistention of the remaining apical and anterior segments compensated for the removal of the posterior segment. In the remaining 4, there was little or no shift of the superior segment of the right lower lobe, the right middle lobe undergoing the major spatial readjustment after removal of the posterior segment.

Posterior Segmental Resection, Left Upper Lobe (Case II, Figs. 5-8): Only one example of posterior segmental resection of the left upper lobe is contained in our series. Here the superior segment of the left lower lobe was responsible for all the spatial readjustment after resection, leaving the apical, anterior, and lingular segments in essentially normal positions.

Apical Segmental Resection, Right Upper Lobe (Case III, Figs. 9-12): Four cases of this particular resection were available for study. The pattern of re-expansion showed no well defined trend except that in no instance did the right middle lobe contribute. The space adjustment was done by the superior, posterior, or anterior segments in various combinations as

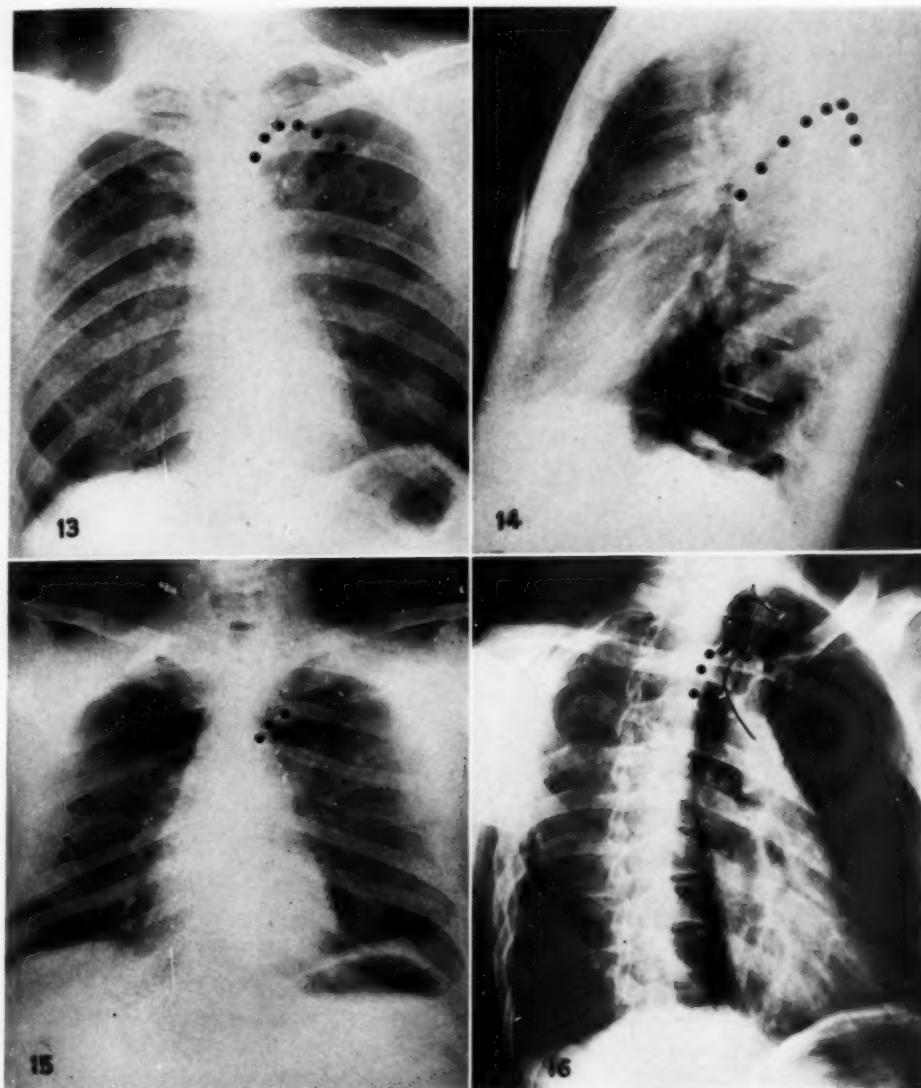
follows: (a) huge anterior, small posterior, and normal superior segment; (b) large anterior, small posterior, and huge superior segment; (c) normal anterior, large posterior, and large superior segment; (d) normal anterior, huge posterior, and normal superior segment.

Apical Segmental Resection, Left Upper Lobe (Case IV, Figs. 13-16): In none of the 4 cases studied following apical segmental resection of the left upper lobe did the superior segment make any contribution to spatial readjustment. In 2 instances, the contribution of the anterior and posterior segments was about equal, in view of their respective size. In a third case, the posterior segment was huge, while in a fourth the anterior segment was of great size, dominating the re-expansion pattern.

Apical Posterior Segmental Resection, Right Upper Lobe (Case V, Figs. 17-20): Twelve examples of apical posterior segmental resection in the right upper lobe were studied. The expansion pattern commonly found in this group was enlargement and posterior displacement of the anterior segment, with overdistention and superior bulging of the right-middle lobe.

In one instance, the superior segment was huge, rising to the level of the third posterior rib, the anterior segment was large, and the middle lobe unchanged. In a second case, there was no change in the size or position of the superior segment and middle lobe, while the anterior segment was huge and overdistended, performing all the spatial readjustment. Some overexpansion and shifting of the superior and anterior segments was evident in a third case, but the middle lobe was greatly overdistended, accounting for the major space filling after resection.

In the other 9 cases in this group, there was no change in the superior segment, but marked enlargement and posterior displacement of the anterior segment and overdistention and superior bulging of the middle lobe were observed. Thus, the anterior segment dominated the spatial rearrangement, aided by the middle lobe.



Figs. 13-16. Case IV. Apical Segmental Resection, Left Upper Lobe

Fig. 13. Postero-anterior view. The superior segment (dots) is of normal size and in normal position with its apex just above the fourth rib posteriorly.

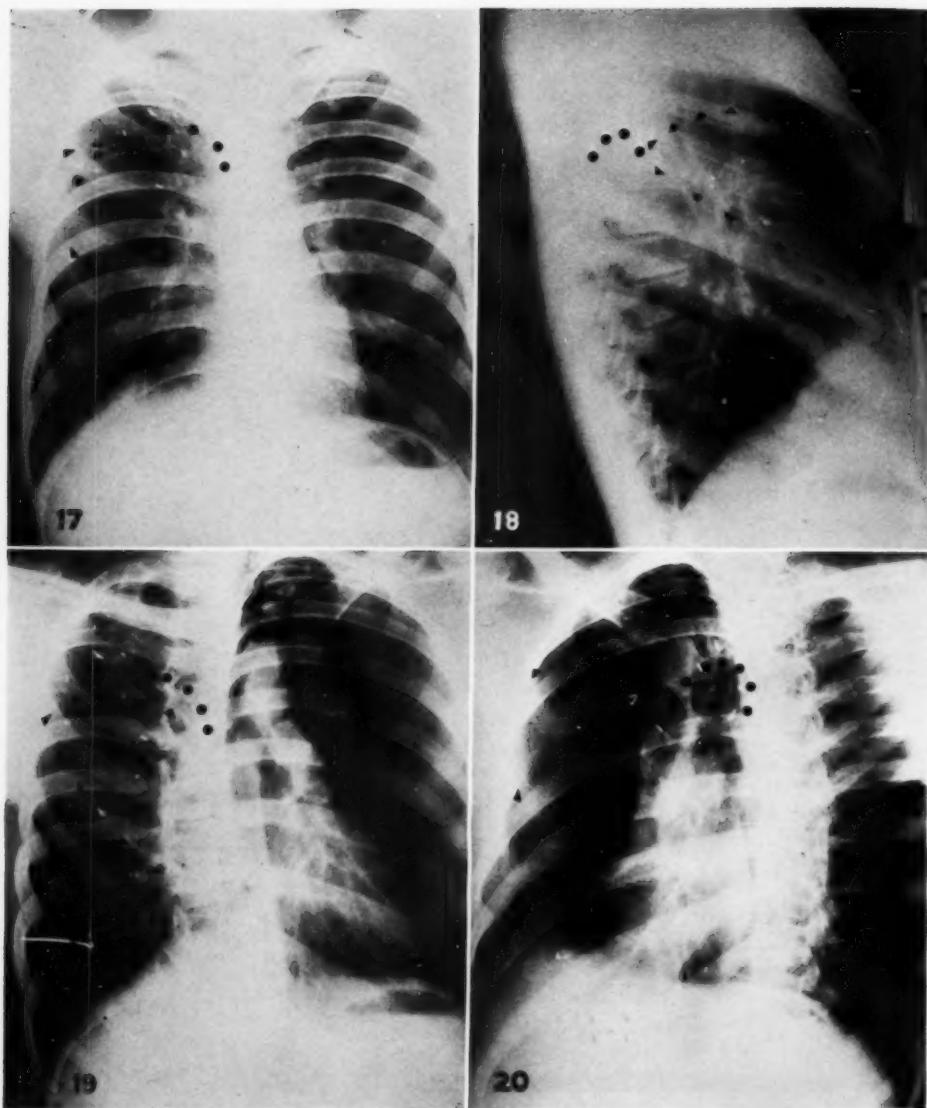
Fig. 14. Left lateral view. There is equal expansion of the anterior and posterior segments to occupy the defect resulting from apical segmental resection.

Fig. 15. Lordotic view. This view emphasizes the greater importance of the remaining segments of the left upper lobe in spatial readjustment as compared to the dot-outlined apex of the superior segment.

Fig. 16. Right anterior oblique view. The large space-occupying anterior segment is seen in relation to the superior segment of the left lower lobe.

Apical Posterior Segmental Resection, Left Upper Lobe (Case VI, Figs. 21-24): Twelve cases of this type of resection were studied. The space filling was performed

mainly by the anterior segment, with slight to moderate assistance from the superior segment. The lingula, unlike its counterpart, the right middle lobe, did not seem to



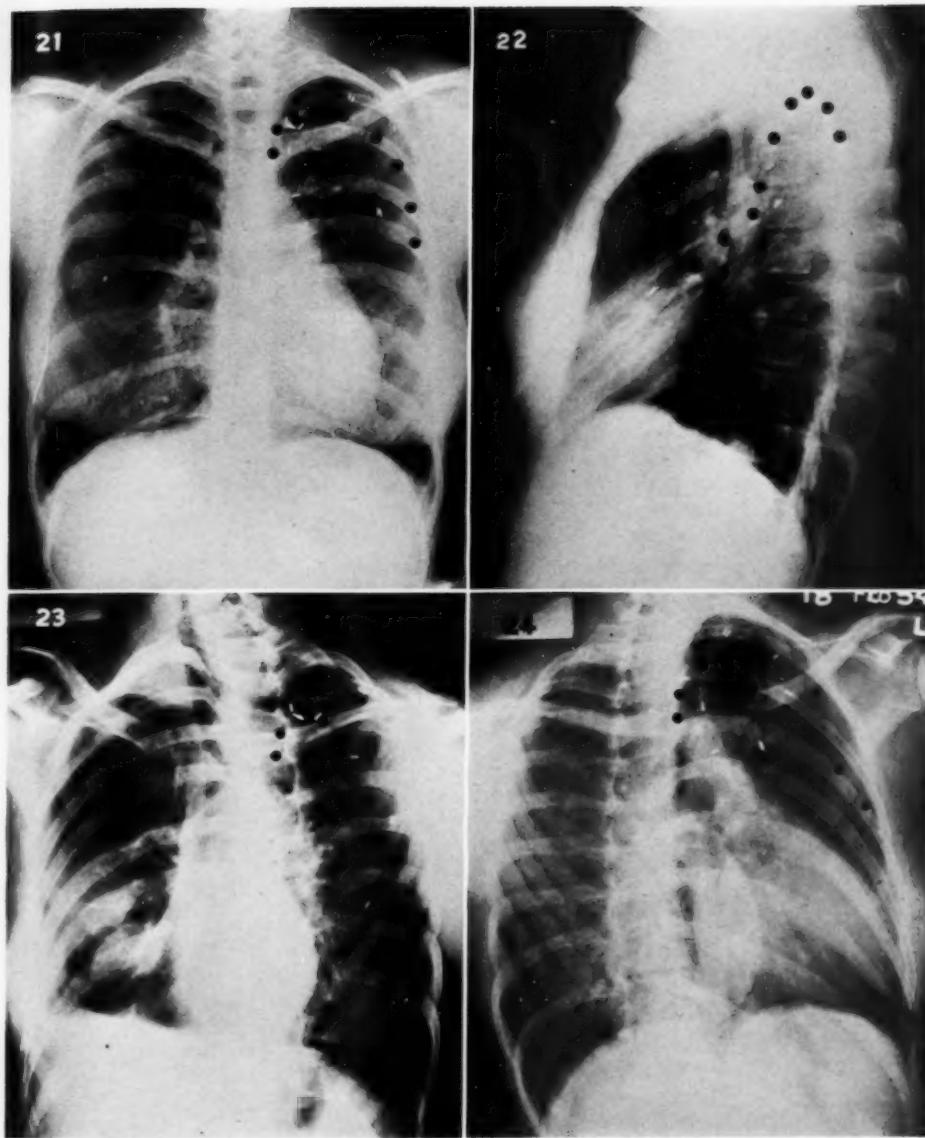
Figs. 17-20. Case V. Apical Posterior Segmental Resection, Right Upper Lobe

Fig. 17. Postero-anterior view. The apex of the superior segment (dots) lies at the level of the fifth rib bed posteriorly. The minor fissure (points) between the anterior segment and the middle lobe crosses the mid-point of the second anterior interspace.

Fig. 18. Right lateral view. The superior segment is in normal position, as is the rest of the right lower lobe. The middle lobe is over-distended, with its projection along the minor fissure bulged superiorly. The edges of the middle lobe are delineated by points. The anterior segment is huge in size and occupies nearly the same amount of space as the normal right upper lobe.

Fig. 19. Right anterior oblique view. The projection of the apex of the superior segment is outlined (dots). The upper margin of the middle lobe (points) crosses the third anterior rib superiorly and follows the course of the bed of the resected fifth rib. The upper fourth of the right hemithorax in this view is filled with the remaining anterior segment of the right upper lobe.

Fig. 20. Left anterior oblique view. This view emphasizes the large amount of space occupied by the anterior segment above the margins of the middle lobe (points) and the apex of the superior segment (dots) of the right lower lobe.



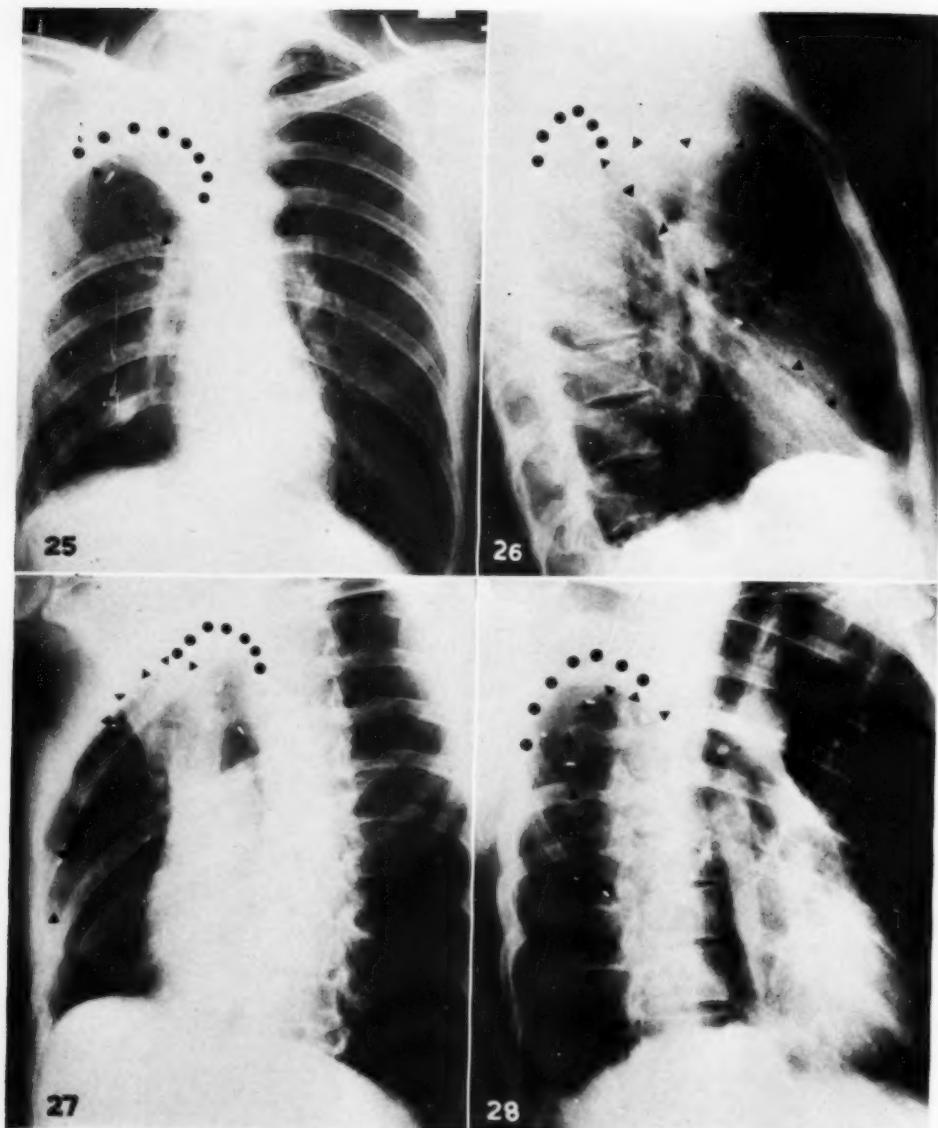
Figs. 21-24. Case VI. Apical Posterior Segmental Resection, Left Upper Lobe

Fig. 21. Postero-anterior view. The superior segment (dots) is large and has risen slightly to the level of the third posterior interspace.

Fig. 22. Left lateral view. The superior segment is outlined by dots. The anterior segment is large and does the major space filling. The more or less linear segmental resection defect (clips) lies obliquely between the anterior and superior segments. The lingula seems unchanged in position.

Fig. 23. Left anterior oblique view. The projection of the superior segment is noted (dots). The remainder of the upper third of the left hemithorax is occupied by the large volume of the anterior segment.

Fig. 24. Right anterior oblique view. Space filling by the large anterior segment is well documented in this view in relation to the dot-outlined superior segment.



Figs. 25-28. Case VII. Right-Upper-Lobectomy, Modified Thoracoplasty

Fig. 25. Postero-anterior view. The apex of the superior segment (dots) overlies the fourth posterior interspace. The minor fissure (points) between the anterior segment and middle lobe overlies the bed of the second anterior rib.

Fig. 26. Right lateral view. The apex of the superior segment has risen slightly in the posterior portion of the right hemithorax. The major fissure between the middle lobe and the anteromedial basal segments has not shifted. The middle lobe is overdistended, with its superior edge in transverse position overlying the second anterior rib bed.

Fig. 27. Right anterior oblique view. The position of the superior segment (dots) in the posterior aspect of the right chest is outlined. The projection of the middle lobe in this view is delineated (points).

Fig. 28. Left anterior oblique view. The space filling by the middle lobe (points) is outlined relative to the apex of the superior segment (dots) in this position.

contribute notably in any instance. Lingular shifts, however, are harder to evaluate than middle-lobe adjustments.

In only 1 case was the superior segment the major space filler, and in this patient the anterior segment was unchanged. In all other instances the anterior segment was greatly to markedly overdistended and posteriorly displaced, with minimal to moderate help in spatial adjustment from the superior segment of the left lower lobe.

Right Upper Lobectomy with Modified Thoracoplasty (Case VII, Figs. 25-28): Five cases of right upper lobectomy with modified thoracoplasty were studied. The right middle lobe dominated the spatial rearrangement in all instances, with little or no change in the position or expansion of the lower lobe superior segment.

DISCUSSION

The advantages of this method of study, in both the early and late phases of management in patients coming to pulmonary resection, are as follows:

1. Partial or complete atelectasis or hematoma of segments adjacent to the resection defect are detected readily.

2. Dural clips define the area of linear fibrosis due to operation and prevent subsequent error in evaluation of reactivation or spread in patients with pulmonary tuberculosis.

3. Dural clips aid in determining the necessity for thoracentesis, the insertion of a polyethylene catheter or chest tube, modifying thoracoplasty, or re-exploration in the postoperative segmental resection patient.

The parenchymal rearrangement following the various segmental resections is more or less constant, although interesting individual variations are observed. The two main factors determining the expansion pattern are: (a) the presence or absence, location, and type, of adhesions; (b) the relative fibrosis, contraction, atelectasis, or emphysema in the diseased resected segments.

A few filmy adhesions are of no consequence. On the other hand, a dense local-

ized area of pleural symphysis in relation to a diseased segment definitely modifies the expansion pattern. Dural clips permit accurate appraisal of the importance of individual pulmonary segments to pleural space filling and eventual obliteration of the segmental defect. For example, a diseased apical posterior segment of the right upper lobe may have dense adhesions between the inferior portion of the posterior segment and the chest wall. Such adhesions prevent compensatory over-distention by the superior segment of the lower lobe, but allow free range of motion to the anterior upper lobe segment and the middle lobe.

The ultimate pattern of pleural space-filling by the pulmonary remnant following segmental resection is well established by the end of the third postoperative week. Further changes, to the end of the sixth postoperative month, are minimal in character, essentially non-existent, except in the occasional patient with serious, slowly resolving postoperative complications.

SUMMARY

1. A series of 50 patients undergoing, for the most part, upper lobe segmental resections for pulmonary tuberculosis have been studied in relation to postoperative expansion of the lung remnant.

2. The edges of the segmental defect, major and minor fissures, and the superior segment of either lower lobe were identified with dural clips.

3. The expansion pattern, from the first day to the end of the sixth month following resection, was studied in various radiological views.

4. Representative cases of the parenchymal space adjustment patterns following various upper lobe segmental resections are presented.

5. The use of dural clip identification is particularly helpful to the thoracic surgeon and radiologist in early postoperative care and evaluation of patients undergoing segmental resection.

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SUMARIO

Patrones de Expansión Pulmonar Consecutivos a la Resección Segmental del Lóbulo Superior

Una serie de 50 enfermos sometidos principalmente a resecciones segmentales del lóbulo superior por tuberculosis pulmonar fué estudiada en cuanto a expansión postoperatoria del resto pulmonar. Los bordes de la brecha segmental, las fisuras mayores y menores y el segmento superior de uno u otro lóbulo inferior fueron marcados con grapas de duraluminio. El uso de estas grapas como medio de identificación se considera en particular útil para el

cirujano torácico y el radiólogo en la asistencia postoperatoria temprana y la justipreciación del estado de los enfermos sometidos a la resección segmental.

El patrón de expansión, desde el primer día hasta el final del sexto mes consecutivo a la resección, fué estudiado en varias vistas radiológicas. Preséntanse 7 casos típicos de los patrones de ajuste del espacio parenquimatoso a continuación de resecciones de segmentos del lóbulo superior.

Intra-Abdominal Egg-Shell Calcifications Due to Silicosis¹

LEWIS G. JACOBS, M.D., BRUNO GERSTL, M.D., A. GERSON HOLLANDER, M.D., and MORRIS BERK, M.D.

INTRA-ABDOMINAL egg-shell calcifications due to silicosis are extremely rare. In a fairly extensive review of the literature only 1 case, reported by Riemer (5), was found. The case to be presented here is an example of extreme egg-shell calcification in the peri-aortic abdominal lymph nodes, unique in our experience. Of 41 patients at the Oakland Veterans Administration Hospital with a clinical diagnosis of pulmonary silicosis, 10 showed intrathoracic egg-shell calcification of varying degree, and 5 intra-abdominal calcification. In 3 of the latter, the calcification was of the mulberry type; 1 was of a rather indefinite amorphous character, and 1 was of the egg-shell variety. In 17 cases no x-ray examination of the abdomen had been made. An additional 50 cases were listed in the x-ray cross index under silicosis, either for diagnostic or differential purposes. Nineteen of these patients were found not to have silicosis, and in 12 records were not available for review. Of the remaining 19, thoracic egg-shell calcifications were found in 3, abdominal in none.

CASE REPORT

A 63-year-old white male was admitted for treatment of cardiac failure and chronic bronchitis on Sept. 27, 1954. He had been hospitalized in 1948 for Buerger's disease with Raynaud's phenomenon, which had been relieved by a bilateral cervical sympathectomy. The chief complaint on the present admission was a persistent cough, productive of about half a cup of yellowish or whitish sputum a day, with no blood, and occasional wheezing. For the past six months the patient had been dyspneic on exertion; lately he had become orthopneic. He complained also of fatigability, weakness, anorexia, and a weight loss of 15 pounds. One week before hospitalization he began to have edema of the feet, which improved following digitalization under the direction of his private physician.

The patient had been a hard-rock miner from 1911 to 1917, and subsequently an electrician. There was no history of exposure to Echinococcus. A chest roentgenogram in 1932 was reported as showing pneumoconiosis and chronic bronchitis. One taken



Fig. 1. Postero-anterior film of the chest. Note the multiple nodular and egg-shell calcifications in both lung fields and hili.

in 1948 demonstrated a diffuse, somewhat nodular increase of lung markings with peripheral calcifications, both nodular and egg-shell in type, with egg-shell hilar calcifications.

Physical examination revealed moderate dyspnea and orthopnea at rest. There was a 2-plus edema of the lower extremities. The neck veins were distended. Blood pressure was 170/80, pulse rate 96, and weight 134 pounds (average weight had been 150). The eyegrounds showed moderate sclerotic changes. The heart was slightly increased in size, with occasional ectopic beats and tones of good quality. P-2 was accentuated and there was a Grade II blowing systolic murmur at the apex. The liver was moderately tender and extended two finger breadths below the costal margin. The dorsalis pedis pulses were not palpable. Bilateral Dupuytren's contractures were observed.

The chest roentgenogram (Fig. 1) showed moderate cardiac enlargement, prominence of the lung roots, slight pulmonary congestion, and multiple ring-like and nodular calcifications in both lung fields and hili. The appearance of the lung fields was unchanged as compared with 1948, but the

¹ From the Oakland Veterans Administration Hospital.

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Fig. 2. Anteroposterior and lateral abdominal views showing egg-shell calcifications in peri-aortic lymph nodes.

heart was slightly larger. Fluoroscopy showed this enlargement to involve mainly the left ventricle. Plain films of the abdomen (Fig. 2) revealed multiple oval calcifications and some arterial calcification. The serologic test for syphilis was negative. Several sputum concentrates were negative for acid-fast bacilli both on direct smear and culture. The electrocardiogram was normal except for multifocal ventricular ectopic beats. The sedimentation rate was 64 mm. in an hour. (Westergren). Other laboratory tests were within normal range. The patient was placed on a cardiac regimen which led to temporary improvement. Three weeks after admission cardiac failure recurred in association with other complications, and the condition progressively deteriorated until death on Nov. 7, 1954.

Only the pertinent findings of necropsy are recorded. Numerous enlarged lymph nodes of almost stone-like consistency were found at the posterior surface of the sternum, about the great vessels of the mediastinum, in the hilus, and in the mesentery and retroperitoneal peri-aortic tissue. Their sectioned surfaces were dark gray and granular; the parenchyma sometimes showed central softening and was only rarely normal. The cut surfaces of the lungs showed numerous discrete oval to irregular grayish-yellow areas of firm or stony consistency, while numerous emphysematous spaces and strands of fibrous tissue were found in other parts of the pulmonary parenchyma. Cultures for fungi and tubercle

bacilli were negative. The heart weighed 600 gm. with evidence of hypertrophy of both right and left ventricular walls. The coronary arteries were extensively involved by sclerosis, and the descending rami were "pipistem."

Microscopic examination of the abdominal and other lymph nodes, the lungs, the spleen, and the liver revealed numerous rounded lesions composed of whorls of rough collagen fibers, with an occasional macrophage heavily laden with grayish pigment between the fibers. The center of the lesion was frequently the seat of calcium deposition or of granular acellular material (Fig. 3). Under polarized light an occasional round or rod-shaped anisotropic body measuring 0.5 micron in diameter and 1 to 10 micra in length could be made out in these lesions (Fig. 4). Giant, epitheloid, and inflammatory cells were absent. In elastic Van Gieson-stained preparations, the collagen fibers were seen to be intensely fuchsinophilic. Morphologically, these findings were characteristic of silicosis. Acid-fast and PAS stains disclosed no microorganisms.

DISCUSSION

Two types of calcification are commonly found in the lungs, hilus, and adjacent lymph nodes in persons with silicosis. One, an irregularly amorphous calcification of the lymph nodes involving much or

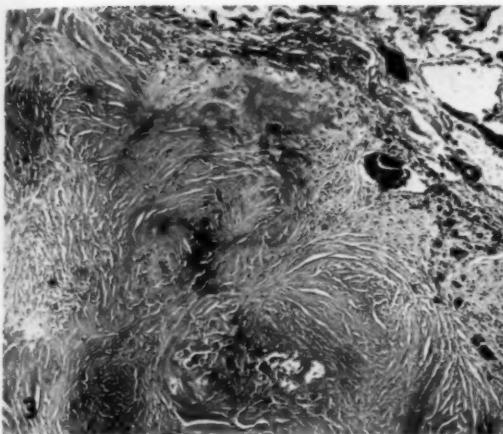


Fig. 3. Pulmonary lesion composed of whorls of collagen fibers. Hematoxylin and eosin. $\times 65$

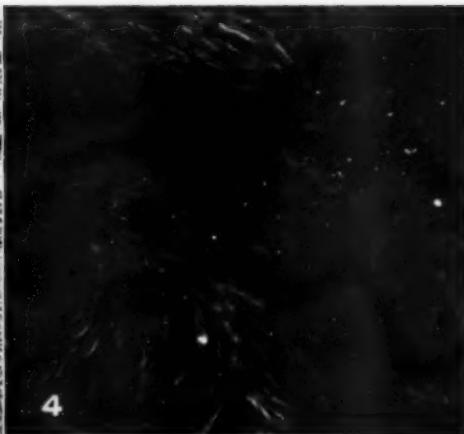


Fig. 4. Similar lesion under polarized light. Hematoxylin and eosin. $\times 65$

all of the central portion of the node, is referred to as the "mulberry" type because of its appearance; the other, a peripheral calcification of the node in a thin layer, is called the "egg-shell" type. The pathogenesis of egg-shell calcifications is controversial, but it is generally accepted that they usually occur in the presence of pulmonary silicosis. Proyard (7) and Eggeneschwyler (1) each reported a single case in which the preponderance of evidence seemed to exclude silicosis, but in neither instance was autopsy performed. Olsen (6) published a case of egg-shell calcification due to sarcoidosis proved by bronchoscopic biopsy. Some authors have ascribed the calcification to silica particles, some to the combined effect of silica and tuberculosis, and some to the tuberculous component alone. We are in agreement with Grayson and Blumenfeld (3) that the presence of silica is the primary cause of egg-shell calcification.

Silicotic calcification may also be found in the abdomen as a result of the lymphatic drainage from the chest. Centripetal lymphatic drainage from the pulmonary periphery to the pleura and diaphragm is a normal occurrence and may be accentuated in pneumoconiosis because of occlusion of the mediastinal lymph channels by fibrosis (2). Communication with the pre-aortic

nodes via the lymph channels in the pulmonary ligament has been described in the pig by Cunningham (cited by Miller, 4); although Miller failed to substantiate a similar connection in man, it would be speculative to assert that it could never occur. At least, such a route of travel for particles from the thorax to the abdomen is possible. Mulberry calcifications, microscopic in dimension, are a common finding in the liver, spleen, and hilus of these organs, and in the surrounding lymph nodes in autopsies of silicotic individuals (2). On the other hand, egg-shell calcifications in the abdomen due to silicosis are exceedingly rare. In Riemer's case there were egg-shell calcifications both in the supraclavicular nodes and in the left subdiaphragmatic area; he believed that these were "apparently within the pre-aortic nodes which receive their lymphatic drainage from the lung bases by way of the crura of the diaphragm." Non-silicotic egg-shell calcifications may also be found in the abdomen; we have seen 1 such case, probably due to hematoma, and the occurrence of egg-shell calcification in hydatid cysts is common in endemic areas.

SUMMARY

A case of silicosis is described in which egg-shell calcifications were present in both

the thoracic and abdominal peri-aortic lymph nodes. This appears to be a rare complication. Death was due to cardiac failure. The calcified abdominal nodes did not appear to contribute to the clinical picture.

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SUMARIO

Calcificaciones Abdominales en Cascarón de Huevo Debidas a la Silicosis

Las calcificaciones muriformes, de dimensiones microscópicas, constituyen un hallazgo común en el hígado y el bazo, en los hilios de estos órganos y en los ganglios linfáticos circundantes, en las autopsias de los silicóticos. En cambio, son sumamente raras las calcificaciones abdominales en cascarón de huevo, debidas a la silicosis.

Describese un caso de silicosis en el que existían calcificaciones en cascarón de huevo en los ganglios linfáticos periaórticos tanto torácicos como abdominales. El enfermo falleció a consecuencia de una insuficiencia cardíaca. Los ganglios abdominales calcificados no parecieron contribuir al cuadro clínico.



Calcified Polyp of the Heart¹

RICHARD E. BUENGER, M.D., OGLESBY PAUL, M.D., and EGBERT H. FELL, M.D.

THE FLUOROSCOPIC visualization of a calcified polypoid tumor of the heart introduces a diagnostic sign to aid in the infrequent recognition of these rare tumors during life. The preoperative or antemortem diagnosis of primary heart tumors has been made several times in the past from symptomatology, clinical findings, and electrocardiographic evidence (2, 13, 18, 21). Routine roentgenographic studies, though usually suggestive only in retrospect, have aided in the correct clinical diagnosis during life in several instances (5, 15, 16, 18).

Because of the successful removal of some of these tumors in the past (1, 4, 17), and the possibility of the removal of a larger number, it is imperative that every roentgenographic means be utilized for their identification, localization, and delineation.

PATHOLOGY

The classification and microscopic features of primary cardiac tumors have been adequately discussed elsewhere (6, 11, 12, 19). In interpreting the roentgenographic findings, however, it is important to reconsider several of the gross aspects. Roughly one-half of the primary cardiac tumors reported are myxomas. The greatest proportion of these are polypoid, intraluminal, and located in the atria, more often the left, near the fossa ovalis. They are frequently covered with a friable thrombus. Sarcomas comprise the second largest group of tumors. Although some of these are polypoid, they are usually intramural, infiltrative, and locally invasive. The remaining primary tumors are either too small or too varied in gross morphology and growth pattern to form a diagnostic group from the roentgenologic point of view.

ROENTGEN FINDINGS

Certain roentgenographic changes, which should be specific, have been used in the preoperative diagnosis of cardiac tumors. The actual peripheral outline of the intramural tumor has been visualized (4, 17). This should be differentiated from cardiac aneurysm and pericardial cyst. Cardiac tumors may become evident by invasion of the pericardial space or the production of a hemopericardium (7, 21). Pneumopericardium can be and has been used to outline such a tumor (14, 17). Differentiation must be made from the more frequent metastatic tumor of the heart or pericardium.

Intraluminal tumors are less readily detected roentgenographically unless they are suspected from the symptoms they produce. Secondary evidence is afforded by localized chamber enlargement due to valve obstruction without rheumatic heart disease (5, 9). Angiocardiography has been used to localize these tumors (1, 3, 8, 10, 11, 17, 20, 22), and should be resorted to more frequently in the presence of bizarre cardiac symptomatology and findings. When an intraluminal defect is detected, it must be differentiated from a mural thrombus.

We were able to discover only one report of calcification visible roentgenographically within a cardiac tumor. This was in a cyst that was removed by Beck (4). Peripheral calcification of a cardiac polyp has been observed histologically once previously (1). The roentgenologic appearance of such a tumor is described in the following case report. The calcification of the periphery of the polyp afforded accurate information as to the size, site of origin, and mobility of the tumor, which was observed to oscillate between the right atrium and ventricle.

¹ From the Departments of Radiology, Medicine and Surgery of The Presbyterian Hospital, Chicago, Ill. Accepted for publication in December 1955.

CASE REPORT

Clinical Findings: A 16-year-old male was first seen on Nov. 8, 1953, with a history of increasing fatigue over the previous four years, with shortness of breath on effort for two years, progressing to the point where he had difficulty in climbing one flight of stairs.

Examination at the time of admission showed the patient to be well developed and well nourished. The pulse was 88 and regular and the blood pressure was 128/88 in both arms. There was no cyanosis. A vigorous venous pulse was visible on the right side of the neck. The thorax showed a slight precordial bulge, and the lungs were clear. The heart was moderately enlarged to the right and left; P-2 was louder than A-2 but was not accentuated. A variable superficial systolic murmur was heard, loudest along the left sternal border in the fourth and fifth interspaces, and there was a loud third early diastolic sound in all areas, varying in intensity with the position of the patient. The abdomen was negative. The right femoral pulse lagged behind that on the left.

Laboratory studies showed the blood hemoglobin level to be 15.0 gm. per cent. The red blood cell count was 4,970,000, and the sedimentation rate was 2 mm. in an hour. Urine specimens were normal. The Kahn blood test was negative, and the non-protein nitrogen and prothrombin levels were normal.

The electrocardiogram was abnormal, showing broad P waves, first degree A-V block (P-R = 0.23 seconds), and a complete right bundle branch block (QRS = 0.13 seconds). Cardiac catheterization revealed a large right auricle, no evidence of an intracardiac or extracardiac shunt, right auricular hypertension (23/0 mm. mercury), right ventricular hypertension (36/10), and marked "ventricularization" of the right auricular curve consistent with tricuspid regurgitation. The femoral arterial oxygen saturation was 94.6 per cent. Angiocardiography was unsuccessful.

Roentgenographic examination of the heart revealed enlargement in the region of the right atrium and ventricle. Fluoroscopically a spherical, peripherally calcified tumor was observed moving back and forth through the tricuspid valve with each cardiac cycle (Fig. 1).

Operative Procedure: At the time of surgical exploration a mass was palpated through an incision in the right auricular appendage. It was felt to occlude the inferior vena cava during systole and to "flop" into the right ventricle during diastole. An attempt at removal was made by guiding the tumor into a rubber glove sutured to the atrial wall. (The right atrial pressure was too high for use of an atrial well.) This procedure had to be abandoned, however, because the heart stopped and considerable time was spent in cardiac resuscitation. The calcifi-

cation within the tumor was palpated at this time; its size was comparable to a hen's egg.

A second operation was performed five months later. Plastic nylon pouches of various sizes had been constructed to be sutured to the atrium to receive the tumor at the time of its amputation. The size of the tumor had greatly increased since the first operation, and at the first attempt at manipulation of the polyp, it was so friable that it broke into many fragments, some of which passed into the lungs, causing anoxia and cardiac arrest.

Pathological Examination: The entire right heart was dilated and the tricuspid valve was grossly incompetent, with virtual absence of the posteromedial cusp, probably as a result of trauma from the polyp. The tumor remaining in the heart was attached by a pedicle 1.0 cm. in diameter to the right atrial wall midway between the orifices of the venae cavae and 1.0 cm. above the coronary sinus. The tumor was jelly-like and friable (Fig. 2). The largest amputated fragment had a calcified shell (Fig. 3) and was made up of myxomatous material centrally.

Histologically the tumor combined myxomatous elements, actively proliferating blood vessels, strands suggestive of smooth muscle, groups of round cells, and deposits of hemosiderin. Scattered spindly giant cells were seen lying in lacuna-like spaces with numerous delicate radiating cytoplasmic processes (Fig. 4). Since the cytoplasmic fibrils had a beaded appearance suggesting cross-striation the tumor was classified as a rhabdomyoma.

COMMENT

Although microscopically there were rhabdomyomatous elements within the tumor, its location, gross appearance, and evolution seem to place it with the large group of "myxomas" reported in the literature. The calcification is postulated to be a degenerative change similar to that found on the tricuspid valve and was probably the result of trauma.

The considerable increase in size over a period of five months is a unique observation in this type of tumor.

SUMMARY

A calcified polypoid tumor of the heart in a boy of sixteen is reported. Roentgenograms showed enlargement in the region of the right atrium and ventricle. The tumor was recognized and localized fluoroscopically, moving back and forth through the tricuspid valve, with each cardiac cycle. An attempt at removal was made, but the patient died.

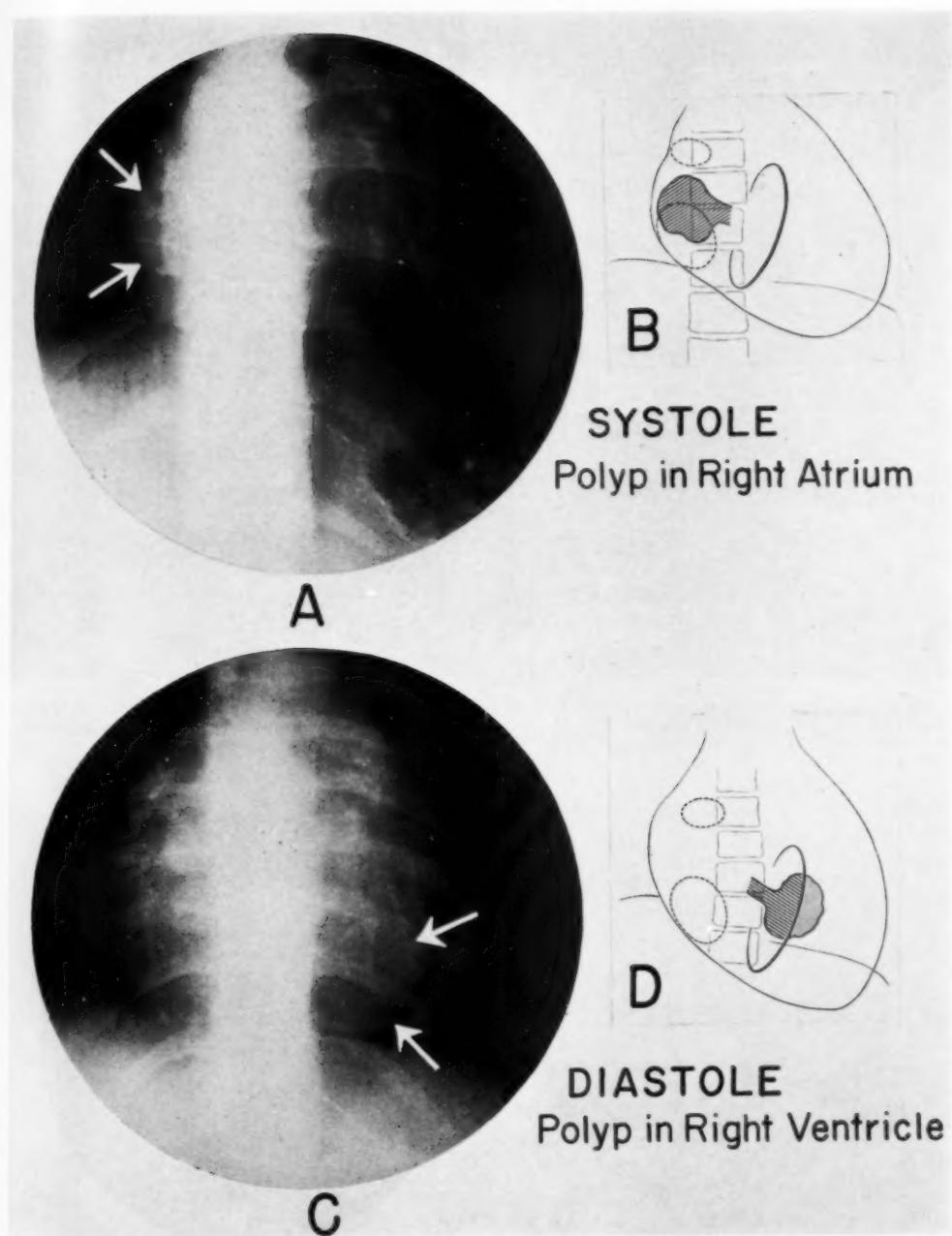


Fig. 1. Roentgenogram (A) and drawing (B) of calcified atrial polyp overlying orifice of inferior vena cava during systole. Roentgenogram (C) and drawing (D) during diastole, showing protrusion of the tumor through the tricuspid valve into the right ventricle.

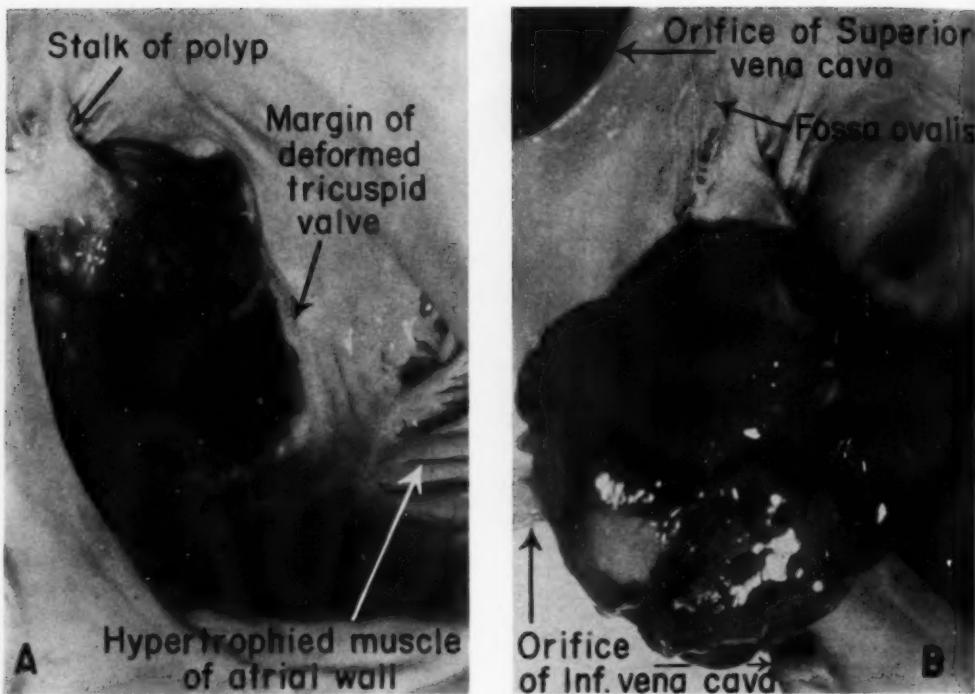


Fig. 2. Photographs of myxomatous base of tumor still attached by pedicle to right atrial wall. Looking from the atrium into the ventricle (A) the tumor is seen to protrude through the deformed tricuspid valve as in diastole. In systolic position (B) the polyp covers the orifice of the inferior vena cava.

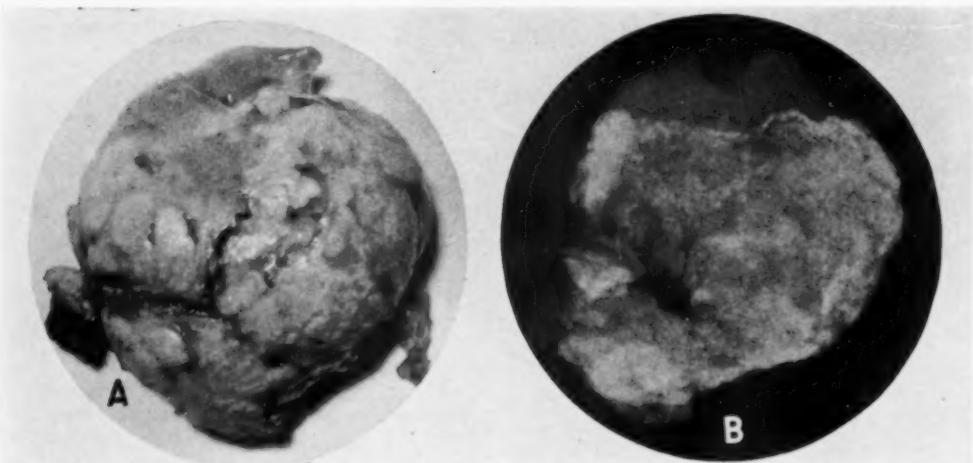


Fig. 3. Photograph (A) and roentgenogram (B) of major fragment of polyp, demonstrating the peripheral calcification which had been visible *in vivo*.

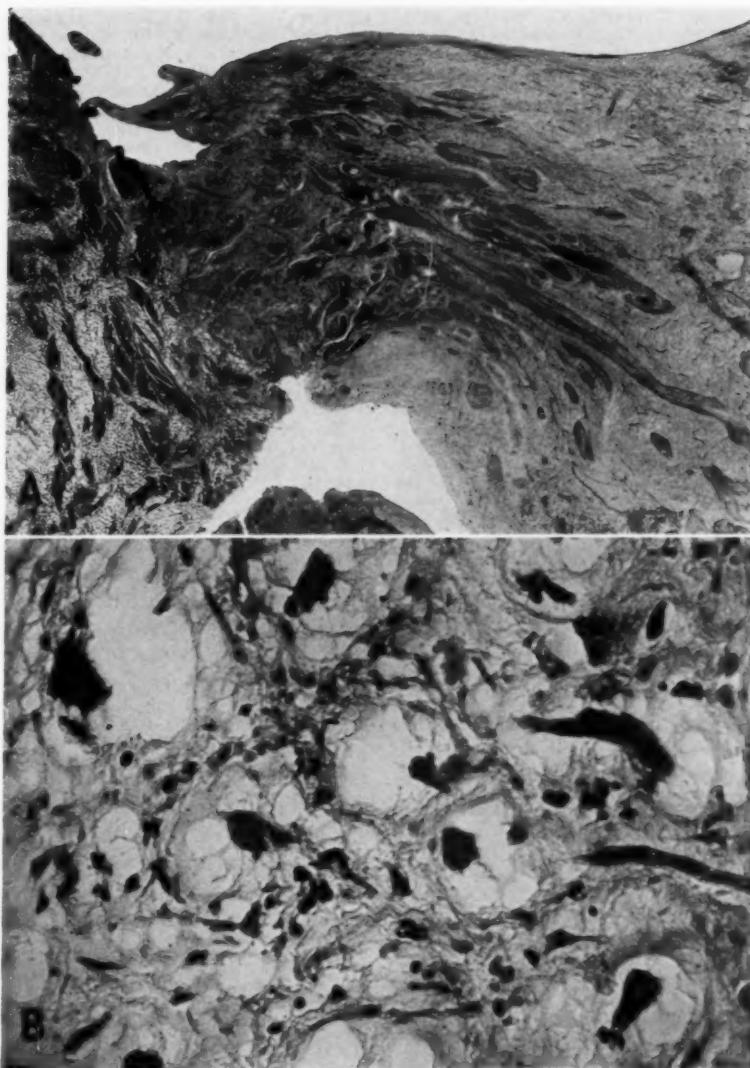


Fig. 4. A. Low-power photomicrograph of pedicle connecting base of tumor (right) to atrial wall (left). $\times c.30$. B. High-power photomicrograph showing "spider" cells in lacunae. $\times c.300$. (Cross striations were demonstrated only at very high power with P.T.A.H. stain.)

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SUMARIO

Pólipos Calcificados del Corazón

Presentase un caso de tumor polipoideo calcificado del corazón en un adolescente de dieciséis años. Las radiografías revelaron hipertrofia en la región de la aurícula y del ventrículo derechos. Fluoroscópicamente, se observó una tumefacción esférica, calcificada periféricamente, que se movía hacia atrás y adelante a través de la válvula tricúspide con cada ciclo cardíaco. La

muerte subrevino mientras se trataba de extirpar el tumor.

Aunque la clasificación histopatológica fué rabdomioma, el tumor parece pertenecer al numeroso grupo de mixomas descritos en la literatura. Se presupone que la calcificación es una alteración degenerativa, probablemente consecuencia de un traumatismo.



Experience with a New Contrast Medium (Hypaque) for Cerebral Angiography¹

J. E. WHITELEATHER, M.D., and R. L. DeSAUSSURE, M.D.

EVERYONE WHO is concerned with cerebral angiography hopes that a new contrast medium may be found which will produce a maximum of contrast with a minimum of ill effects. With such a hope in mind, we decided, early in 1954, to investigate the properties and possibilities of a new urographic medium being tested by Dr. T. D. Moore, Professor of Urologic Surgery at the University of Tennessee (1). The material, then identified as Win 8308-3, was supplied by the Winthrop Laboratories and has since become available as Hypaque Sodium 50 per cent. It was found to produce superior uograms in man without venous burning during injection, and with a minimum of undesirable side-effects. Winthrop investigators had found it to be less toxic in animal tests than similar compounds and to produce no intimal damage in the ear veins of rabbits after repeated injections (2).

Hypaque Sodium is a sodium 3,5 diacetamido-2,4,6-triiodobenzoate, containing 59.87 per cent iodine, with a molecular weight of 636.0, supplied as 50 per cent aqueous solution. We wished to use the medium in a solution of that strength, since not all percutaneous carotid injections take place smoothly or rapidly enough to prevent some dilution. The resulting reduction in contrast is particularly apparent in the smaller vessels.

EXPERIMENTAL STUDIES

While certain workers here and abroad have used 50 per cent solutions in some instances, it did not seem advisable to proceed with human injections until tests had been made in animals to gain a more definite idea of the effect on the cerebrovascular system. Although there are many

methods of testing the pharmacotoxic effects of such agents, we were concerned with the direct effect upon the vascular tree of the brain and brain tissue as well as the immediate response of the animal to the injection. Broman, Olsson, and collaborators (3-5) have described a procedure whereby they compared the effects of various substances, mainly iodine-containing contrast materials, on the blood-brain-barrier (BBB) of the rabbit. Injecting the material under study into the carotid, they observed any direct effect on the pial vessels through a trephine hole in the calvarium. Vascular permeability was determined by the presence or absence of staining of brain tissue by a supravital stain, trypan blue dye, introduced into the general circulation through the femoral vein. Trypan blue is of such a molecular size that it will not pass through the intact cerebral vessel but will extravasate if the vessel is sufficiently injured. Olsson *et al.* reported that, in general, more BBB damage resulted when a urographic medium was injected with enough pressure to remain in relatively pure solution in larger amounts over a longer period of time, or in higher concentrations. There was also a definite difference in types of media, and sometimes in the same medium supplied by different manufacturers.

It was decided to follow the Broman-Olsson method as closely as possible so as to be able to make some comparison of our results with their published findings with other media. Rabbits were first used for the experiments, but dogs were available, and vascular dissection and cannulation are much easier in the latter animals. They stand the surgical trauma better, more comparable amounts of media can be

¹ From the Department of Neurosurgery of the University of Tennessee and the Baptist Memorial Hospital and the Department of Radiology of the Baptist Memorial Hospital, Memphis, Tenn. Presented at the Forty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 11-16, 1955.

TABLE I: SCHEME FOR GRADING
BLOOD-BRAIN-BARRIER STUDIES

NAME	HOSPITAL	DATE	MEDIUM
A. Local Tissue Toxicity (Extravasation of Trypan Blue)			
No evidence of extravasation of trypan blue.....		0	
One or two small discrete areas of blue on injected side.....		2	
Faint blue, 10 to 50 per cent of injected side.....		4	
Distinct blue, 50 to 100 per cent of injected side.....		6	
Uniform blue on injected side, some staining on opposite side.....		8	
Both hemispheres faint blue.....		8	
Both hemispheres deep blue.....		10	
Stasis, injected side.....		12	
Stasis, both hemispheres.....		14	
B. Systemic Toxicity (Convulsions)			
No effect.....		0	
Generalized tenseness or turning of head to injected side.....		2	
Clonic convulsions, less than 1 minute.....		4	
Clonic convulsions, more than 1 minute.....		6	
Tono-clonic convulsions.....		8	
C. Effect on Respiration			
None.....		0	
Dyspnea.....		2	
Transient apnea.....		4	
Respiratory failure, necessitating artificial respiration.....		6	
Total score: A plus B plus C = 28			

used, and the dog brain is more similar to that of man.

Procedure: Adult dogs of similar age and weight (from 25 to about 40 pounds), in good condition, were obtained. Nembutal was used intravenously to produce a light anesthesia which did not mask reactions to the injections. Both carotid arteries and jugular veins were dissected out. The right femoral vein was cannulated with a small polyethylene tube through which normal saline was allowed to drip, *via* a three-way stopcock connection, to prevent clotting. Immediately prior to the injection the jugular vein on the injected side was clamped and opened cephalad to the clamp to permit most of the medium to escape. Any reaction could then be considered as due primarily to cerebral injury and not to general toxicity. During our first series of experiments, the carotid artery was not clamped prior to injection, as we were afraid that even temporary reduction of blood flow might add the effects of cerebral anoxia to those of the injection. Injection was accomplished by hand pressure on a 50-c.c. syringe through 12 inches of polyethylene tubing. While the pres-

sure could not have been consistent, it usually was sufficient to exclude blood flow.

Since Olsson had shown that cerebral vessels recovered rather promptly from injection injury, 150 to 250 c.c. of 0.2 per cent trypan blue dye, aged two to six weeks but freshly filtered, was allowed to run into the femoral vein by gravity within ten minutes after the carotid injection. When tissues had become deeply blue-stained, the animal was dispatched by bilateral pneumothorax or intracardiac injection of 10 per cent formalin. Both jugular veins were incised and the carotids perfused with saline to wash out post-mortem blood, followed with 10 per cent formalin to aid fixation and prevent post-mortem changes. The brain was removed, photographed in color, and placed in formalin for complete fixation. It was then sectioned serially and the cut sections were photographed when staining was present. Blocks were cut and microscopic sections were studied for stasis, punctate hemorrhages, and faint dye extravasation, by Dr. George Bale of the Baptist Hospital Pathology Department..

A system of grading degree and extent of brain staining, respiratory effect, and neuromuscular response, as devised by J. O. Hoppe (6) was adopted and records were kept for each animal (Table I). Sections B and C (respiratory and neuromuscular) of the table were later used to record the effects of human injections. By adding the numerical equivalents for each category, a figure could be obtained for comparison of the effect of injection of each animal or patient.

Diodrast 35 per cent (iodopyracet) has been so widely employed for cerebral angiography that any new compound must be compared with it. Diodrast as used for this purpose contains 50 per cent iodine in 35 per cent aqueous solution. Since Urokon Sodium 30 per cent had been used in several places and Urokon Sodium 50 per cent was available, it was decided to extend the investigation to include these media also. Urokon Sodium differs slightly from Hypaque Sodium and Dio-

dраст, being sodium acetrizoate (sodium 3 acetylaminio-2,4,6-triiodobenzoate). It contains 65.8 per cent iodine with a molecular weight of 578.9 and is supplied in 30 per cent and 50 per cent aqueous solutions. The manufacturers (Mallinckrodt Chemical Works) generously furnished adequate material for experimental study.

We began our investigations by injecting 10 c.c. of a specific medium and increasing the dosage up to 50 c.c. in successive dogs. Each test was repeated several times with the same quantity of the same medium to eliminate, as far as possible, individual sensitivity. A 10-c.c. dose is equivalent to about 100 c.c. in man, in relation to body or brain weight. Diodrast, in amounts as large as 50 c.c. in a single dose, did not produce significant reactions or evidence of BBB damage. The same procedure was repeated with Hypaque Sodium with equally good results and with no evidence that the higher concentration was more toxic. Urokon Sodium 30 per cent produced very little neuromuscular or respiratory effect but did result in definite BBB damage (trypan blue extravasation) in amounts of 30 c.c. in single injections. Urokon Sodium 50 per cent, even in doses of 10 c.c., routinely caused convulsions. It induced permeability of the BBB in various degrees as indicated by very faint to intense local staining or diffuse overall faint discoloration of one or both hemispheres. On two occasions the animal died shortly after carotid injection in a state of continuous convulsions.

Our next series of tests were set up to simulate actual angiographic procedures. Each animal was subjected to a series of five 10-c.c. injections separated by intervals of two to ten minutes. The reactions to each injection were a little less than with larger doses, but the cumulative effect on the brain capillaries was the same for each type of medium.

Although reactions were minimal with Diodrast and Hypaque Sodium, it was felt that some capillary permeability must be occurring, particularly with large injec-

tions, that were not demonstrable with trypan blue. Hoping to find a more sensitive indicator, we changed to 0.5 per cent sodium fluorescein, employing various amounts up to 250 c.c. All tissues other than the brain were stained an intense yellow and, in two or three instances, after moderately large injections of Urokon Sodium 50 per cent the brain was uniformly yellow. However, under a Woods filtered ultraviolet light, very little fluorescence was observed. Since sodium fluorescein seemed less satisfactory than trypan blue and was difficult to photograph in color, the use of the blue dye was resumed.

Several puzzling phenomena were observed. One was the occasional diffuse staining of both hemispheres following unilateral carotid injection; another was the large amount of certain media that the animals could tolerate without evidence of BBB damage. In order to follow the vascular distribution of the dye and obtain a better understanding of the anatomy of the carotid system in dogs, an x-ray machine was set up and angiograms were made. The common carotid of the dog is a fairly large vessel which follows a straight line along the maxilla, giving off a number of small branches, of which the internal carotid is but one. The bulk of the medium filled the common carotid artery, with only a small amount entering the internal carotid. With a large rapid injection, there was a considerable reflux into the aorta and thence into the homolateral vertebral and contralateral carotid and vertebral arteries, which probably explains the occasional staining of the opposite hemisphere. Thereafter, the common carotid artery was dissected well beyond the internal bifurcation and ligated, as were most of the branches, so as to direct the medium into the internal carotid artery. A bulldog clamp was placed proximal to the needle just before injection and removed immediately thereafter.

A fresh start was made, with repetition of the same procedures, in the same sequence, beginning with 10 c.c. and increasing the dosage up to about 30 c.c., with as

rapid injection as possible—six to fifteen seconds, depending upon the amount. Reactions were similar to those observed before with the same types of media but were a little more pronounced and were observed with smaller quantities of medium. Again convulsions and seizures followed injection of Urokon Sodium 50 per cent but did not occur after Diodrast 35 per cent or Hypaque Sodium 50 per cent.

In some instances, there was no correlation between post-injection reaction and trypan blue demonstration of BBB damage. Most frequently, there were severe respiratory rate changes or convulsive seizures without brain staining.

It appeared that both dye staining and neuromuscular response were valuable indications of cerebrovascular injury, but that the neuromuscular reaction might be more sensitive.

In order to record these reactions and permit subsequent study and comparison, colored motion pictures were made in each instance from the moment of injection until all reactions had ceased or it appeared that none would occur.

Although the previous injections of different media were repeated often enough that results could be almost uniformly predicted, there was occasionally some variation in response that made it seem possible that individual animal sensitivity to specific media could not be excluded. A new series of tests, with two or more types of media in the same animal, were devised and carried out. This, of course, negated the value of trypan blue staining, as it was not possible to determine which medium caused the stain. Dye was still administered in most experiments, however, in order to compare BBB damage with any reaction that might have occurred.

At the beginning of this series, 10 c.c. of Hypaque Sodium was injected first, followed in five to ten minutes by 10 c.c. of Urokon Sodium 50 per cent. In no instance did any reaction result from the initial injection of Hypaque Sodium, but in several tests severe convulsions followed the later

injection of Urokon Sodium. With reversal of the order of injection, seizures resulted in 2 out of 3 trials with both Urokon Sodium 50 per cent and Hypaque Sodium 50 per cent; even Diodrast 35 per cent caused a strong tonic muscular contraction when injected after Urokon Sodium. It would appear that Urokon Sodium left the carotid system unusually sensitive.

In order that we might be certain that it was not simply multiple injections that caused the neuromuscular reactions, another series of experiments were carried out in which the same medium was injected in 10-c.c. amounts two and three times with ten-minute intervals between injections. (This had been done first, before we began ligating the common carotid distal to the bifurcation.) Diodrast 35 per cent and Hypaque Sodium caused no reactions nor evidence of BBB damage. Urokon Sodium 50 per cent was less irritant when used by itself but did result in strong muscular tonic contraction away from the injected side.

CLINICAL EXPERIENCE

Our results with animal experimentation encouraged us to try Hypaque Sodium in man. Carotid angiography was performed on the left in two planes with 17 c.c. of Diodrast for each injection, and on the right with Hypaque Sodium, 10 c.c. for each injection (2 c.c. were always left in the tubing). Except for a slight pull of the head toward the injected side, there was no reaction to either medium. The films on the right were of distinctly greater contrast and opacity (Hypaque) than on the left (Diodrast), even though the dosage of Hypaque was approximately one-half that of Diodrast.

Subsequently, Hypaque Sodium 50 per cent has been used routinely, and over 300 carotid or vertebral angiograms have been obtained. All have been done by the percutaneous method with only local anesthesia, except in children or when the patient's condition has warranted a general anesthetic. Most of the patients exhibit slight flushing of the face on the injected

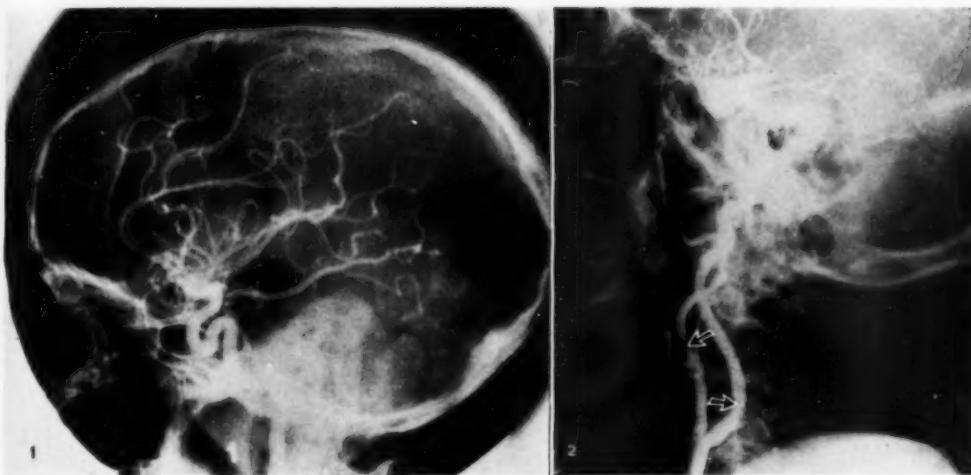


Fig. 1. Normal lateral angiogram.
Fig. 2. Carotid plaque with constriction.

side and experience moderate burning. Uncooperative patients frequently turn the head slowly toward the injected side, but there are no sudden jerks as with Diodrast or Urokon 30 per cent. There have been a few carotid sheath injections, but these have not been painful and resorption has been rapid. Other side-effects have been minimal, with only 5 or 6 patients experiencing nausea or vomiting.

Two undesirable reactions occurred that may not have been related to the type of medium. One patient, being studied because of frequent jacksonian seizures, had a convulsion immediately following the injection. Though he had also had one on the x-ray table just before, the second one must be considered as due to the injection. In another patient, who had been having recurring attacks of facial numbness, ataxia, and hemiparesis, aphasia and hemiplegia developed immediately after bilateral carotid angiography in two planes. The angiograms showed arteriosclerotic narrowing of both carotid arteries and thrombotic occlusion of the left posterior temporal artery. Recovery was almost complete after two days.

Electroencephalographic tracings were obtained for 2 patients immediately before, during, and after carotid injections

and, although it was not possible to exclude all A.C. waves derived from the x-ray apparatus, no alteration in the wave pattern occurred as a result of the injection. A number of patients suspected of having carotid thrombosis have been subjected to percutaneous injection and additional unsuspected thromboses have been found. In no instance did any reaction or injury result, but the demonstration of the thrombosis as well as of the collateral circulation has been superior to that obtained with Diodrast. (When thrombosis is suspected, only 5 c.c. of medium is injected, but 10 c.c. amounts have not been harmful.)

The brilliance of the angiograms has increased our ability to recognize arteriosclerotic plaques and constrictions, as well as other changes of arteriosclerosis, in the smaller brain vessels. The correlation of sclerotic vascular changes in the angiogram and cerebral atrophy in the pneumogram has been most interesting. Vertebral angiography in the axial projection has nicely demonstrated vascular displacement in the posterior fossa. Tumor stains, hemangiomas, vascular fistulas, and slight displacements of small vessels have been much easier to identify than with Diodrast angiography, in spite of the reduction of dosage. A few carotid sheath injections

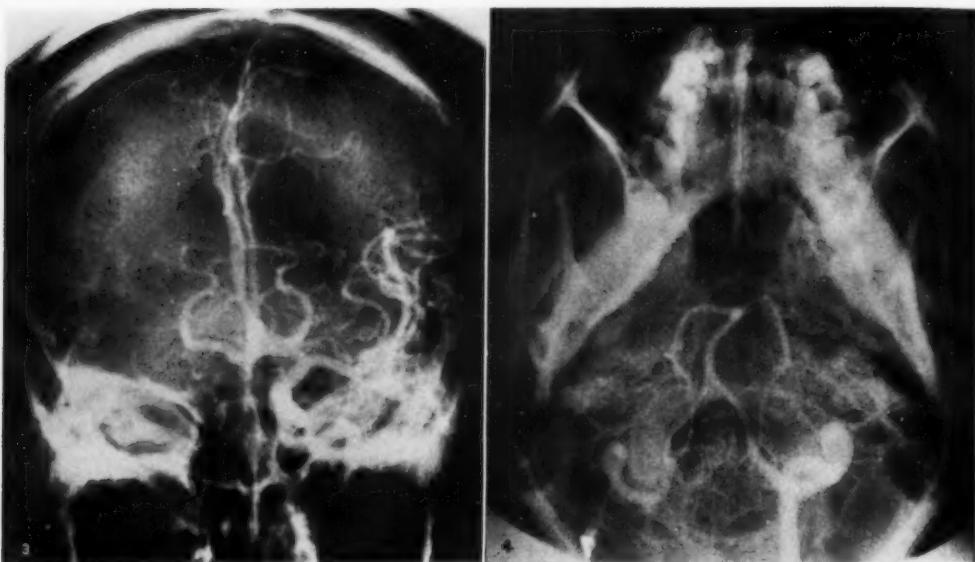


Fig. 3. Normal anteroposterior angiogram.
Fig. 4. Axial vertebral angiogram: basilar artery displaced by tumor of left cerebellum.

have occurred, but there was rapid absorption without much pain and no sequelae.

DISCUSSION

Dr. Bale was unable to find much in the microscopic sections to add to the gross findings of dye staining of brain tissues. We had hoped that some cases in which severe neuromuscular reactions occurred, without gross staining, would show microscopic evidence of capillary permeability as described by Olsson. Perhaps, if we had studied freshly cut sections, we might have been able to see perivascular red cells, but all of the brains were formalin-fixed at the time of sectioning. Unstained and stained sections were prepared and proved negative.

We had also hoped to conclude studies on two new media that became available too late to complete a full series of animal tests. The Mallinckrodt Chemical Works furnished us with adequate quantities of Miokon Sodium 50 per cent (sodium diprotriizoate) which contains 57.5 per cent iodine. So far, test injections of 10 c.c. and 20 c.c. have been administered to dogs without evidence of BBB damage or neu-

romuscular reactions. Some temporary decrease in respiratory rate was observed but was not considered significant. Renografin 76 per cent (sodium and methylglucamine diacetylaminotriiodobenzoates) has been recently supplied by E. R. Squibb & Sons but there has been time to run only two test injections. The material seems to be well tolerated but, like Miokon Sodium, will require further study.

SUMMARY

Hypaque Sodium 50 per cent and Urokon Sodium 30 per cent and 50 per cent have been compared with Diodrast 35 per cent by repeated carotid injections in dogs. Every effort was made to make quantity, rate of injection, and procedure uniform. Blood-brain-barrier injury was demonstrated by trypan blue as a follower dye but this was not found to be as reliable as a system of grading the respiratory effects and neuromuscular reactions. Hypaque Sodium proved to be no more irritant or toxic than Diodrast but provided superior contrast. There were fewer side-effects than with Diodrast, such as nausea, allergic reactions, subjective complaints, etc.

Urokon Sodium in 30 per cent solutions was fairly well tolerated but did produce evidence of BBB damage in lesser amounts than Hypaque Sodium. Urokon Sodium 50 per cent almost uniformly caused convulsions or strong tonic muscular contractions, with severe BBB damage.

In 300 cerebral or vertebral angiographic studies with Hypaque Sodium 50 per cent in patients of all ages, there were no untoward effects directly traceable to the medium. Radiographic contrast has been uniformly better than with Diodrast, with one-half the dosage. The diagnostic quality of the films is unquestionably better, and observers have been able to arrive at diagnostic opinions with more certainty.

Miokon Sodium 50 per cent and Renografin 76 per cent show promise, but have been inadequately tested in dogs and have not been used clinically.

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SUMARIO

Observaciones con el Hypaque Sódico para la Angiografía Cerebral

El Hypaque Sódico al 50 por ciento y el Urokón Sódico al 30 por ciento y al 50 por ciento fueron comparados con el Diodrasto al 50 por ciento en repetidas inyecciones en la carótida de perros. Hízose todo lo posible para uniformizar la cantidad, la velocidad de la inyección y el procedimiento. Con el azul de tripán como colorante consecutivo se descubrió la lesión causada en la valla hemo-cerebral, pero no resultó aquél tan fehaciente como un sistema de graduación de los efectos respiratorios y las reacciones neuromusculares.

El Hypaque Sódico no resultó ser más irritante o tóxico que el Diodrasto, pero proporcionó un contraste superior, habiendo con él menos efectos colaterales, tales como náuseas, reacciones alérgicas, síntomas subjetivos, etc., que con el Diodrasto. El Urokón Sódico en solución al 30 por ciento fué bastante bien tolerado,

pero produjo signos de lesión de la valla hemo-cerebral a dosis menores que el Hypaque Sódico. El Urokón Sódico al 50 por ciento provocó casi invariablemente convulsiones o fuertes contracciones musculares tónicas, con intensa lesión de la valla hemo-cerebral.

En 300 estudios angiográficos cerebrales o vertebrales con Hypaque Sódico al 50 por ciento, en enfermos de toda edad, no hubo efectos adversos imputables directamente al medio. El contraste radiográfico fué uniformemente mejor que con el Diodrasto, a la mitad de la dosis. La calidad diagnóstica de las radiografías es indudablemente mejor y los observadores han podido formular dictámenes diagnósticos con mayor seguridad.

El Miokón Sódico al 50 por ciento y el Renografin al 76 por ciento ofrecen esperanzas, pero no han sido usados clínicamente.

Immediate and Continuous Uptake Studies of I¹³¹ in the Diagnosis and Treatment of Hyperthyroidism¹

SOL TAPLITS, M.D., ARCHIE FINE, M.D., and LEE S. ROSENBERG, M.D.

THE USUAL procedure in the diagnostic use of radioiodine in thyroid conditions is a twenty-four-hour determination of the uptake of the orally administered iodine in the gland (1). The desirability of arriving at a diagnosis in a shorter period of time is apparent, and many investigators have studied uptake measurements during the first hour following administration of the isotope.

In 1951, Kriss (2) described a one-hour radioiodine uptake study in which the intravenous route of administration was used, with readings taken immediately and every ten to fifteen minutes thereafter for one hour. The dose given was 40 to 100 microcuries. A clear separation of euthyroid from hyperthyroid subjects was possible in twenty minutes and, in instances of high uptakes, as early as five minutes. In comparing these observations with the twenty-four-hour readings in the same cases, it was found that many patients in whom the results were quite clear-cut at one hour showed equivocal findings at twenty-four hours. As a matter of fact, the uptake in 2 hyperthyroid patients after twenty-four hours was less than after the one-hour test. Kriss believed the initial rapid uptake to represent chiefly trapping of iodine. Morton *et al.* (3) also described a one-hour study, as did Crispell, Parson, and Sprinkle (4). The latter workers administered doses of 4 to 8 microcuries of radioiodine and concluded that the one-hour test was as reliable as the twenty-four-hour study in distinguishing between hyperthyroid and euthyroid subjects. The differentiation between hyperthyroid and hypothyroid subjects, however, was less satisfactory than at twenty-four hours. Scott (5) described a

one-hour study in which I¹³¹ was given intravenously. Two counters were used, one on each side of the neck, and ten to twelve plots were made in one hour. He commented favorably as to the possibilities of this test.

METHOD A

(Figure 1)

Since 1951, we have developed a rapid immediate uptake test for I¹³¹ administered by the oral route. In our earlier work, we used a survey meter and a bismuth cathode tube, making readings over the thyroid at fifteen-minute intervals for a period of one hour. For the past two years, a scintillation counter has been employed, affording a continuous recording of thyroid radioactivity for one-half hour after administration of I¹³¹, by means of a ratemeter to which an Esterline-Angus recorder is attached.

A curve is obtained representing thyroid uptake plotted against time. The upward sweep of the curve has been found to approximate closely a straight line in nearly all cases. The slope of this line is measured, and the angle of slope is then expressed as a percentage of a 90° angle.

In order that the results of the immediate uptake curves in different patients (and in the same patient from time to time) be comparable, it is essential that the factors which may influence any individual curve remain constant. The only variable then is the avidity of the thyroid for iodine. Those factors which must be kept constant in every case are listed below, followed by the figure which we use for each, in parentheses.

(a) Amount of tracer dose administered (10 microcuries when the scintillation

¹ From the Department of Radiology and the Radioisotope Unit, Jewish Hospital, Cincinnati, Ohio. Presented at the Forty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 11-16, 1955.

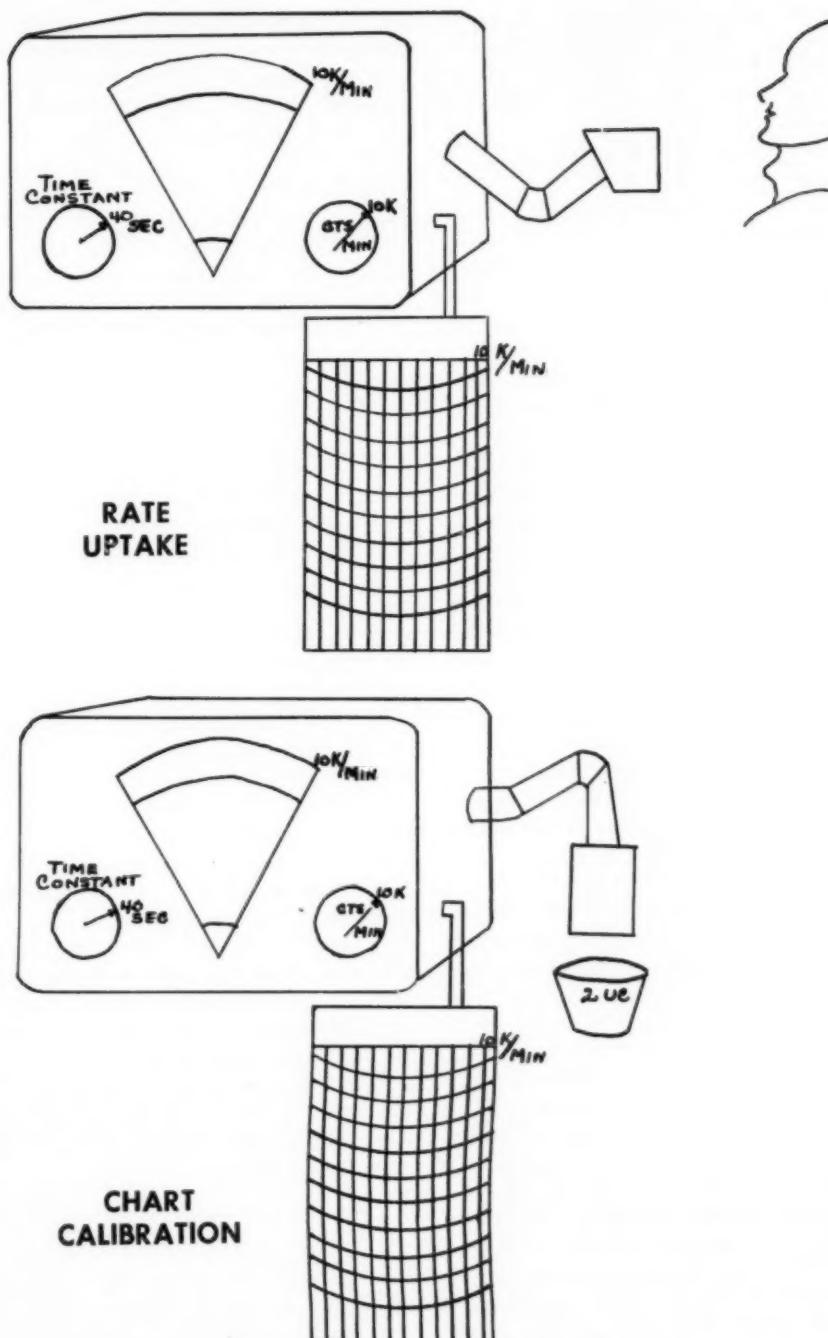


Fig. 1. Method A. Tracer dose 10 μ c. Chart calibration 2 μ c.

counter is used, as at present; 50 microcuries in the earlier cases in which the bismuth cathode tube was used or 100 microcuries when the survey meter was employed).

(b) Speed of the recorder chart (6 inches per hour).

(c) Scale used on the rate meter (10,000 counts per minute).

(d) Distance of tube from calibration standard (about 9 cm. as described below).

(e) Ratio of tracer dose to calibration standard (5 to 1).

(f) Counter sensitivity per microcurie (5,000 counts per microcurie).

Factor (d), the distance of the tube from the calibration standard, is measured as follows: 2 microcuries of radioiodine, one-fifth of the tracer dose, is placed in a wax cup. The volume of the solution is approximately 1 c.c. The scintillation counter is lowered until the needle of the Esterline-Angus recorder rises to a full-scale deflection of 1 milliamper. This distance is about 9 cm., the same as that between the scintillation crystal and the patient's neck in the immediate uptake test.

The level of the base-line of the curve deserves some mention. Although its position does not affect the slope of the uptake curve, and is therefore not important in interpretation of the latter, it should be kept reasonably low to provide enough room on the chart for a satisfactory recording of the uptake. Factors responsible for a high position of the base-line include: (a) high background count; (b) improper position of the patient during the immediate uptake test (recumbent); (c) residual activity in the esophagus. These may be minimized, and the position of the base-line maintained at a satisfactory level, by attention to certain details. Proper shielding and storage of radioactive materials at a considerable distance from the test room keep the background count at a low enough level. The examination should be done with the patient in the erect or semi-erect sitting position, so that the radioactive material in the stomach

falls downward and is therefore farther from the counter. At least 100 c.c. of water should be swallowed after administration of the I^{131} , thereby washing most of the isotope from the upper esophagus. Such pathologic conditions as cardiospasm or upper esophageal diverticulum might theoretically cause elevation of the base-line because of retention of activity in the area "seen" by the counter, but such problems have not arisen in our cases.

All patients who undergo the immediate uptake study are also examined for total uptake at twenty-four hours. For this reading, the scintillation counter is placed at a distance of 35 cm. from the neck. Comparison with a standard is made, and the percentage uptake is calculated in the usual fashion.

The use of Method A for carrying out the immediate uptake study is limited by the necessity of using exactly the same dose in every instance. Some laboratories, in which exact measurement of the test material is not feasible, prefer to obtain their test doses from commercial outlets, in the form of small bottled solutions of known strength. One company sends a number of such bottles (all of equal strength) at weekly intervals. The entire amount of solution in each bottle must, of course, be used for any given test, and the amount of radioiodine which any particular patient receives varies, depending on the day that the test is performed. In order to adapt the immediate uptake study to this type of laboratory, alternative methods have been developed, in which it is not necessary to use the same dose for every test. Such a modification has been successfully used in the private office of one of the authors (A. F.).

METHOD B

(Figure 2)

In Method B, a variable tracer dose is used instead of a constant dose. The calibration standard is one-fifth of any given tracer dose. The calibration standard may be placed in a container and the

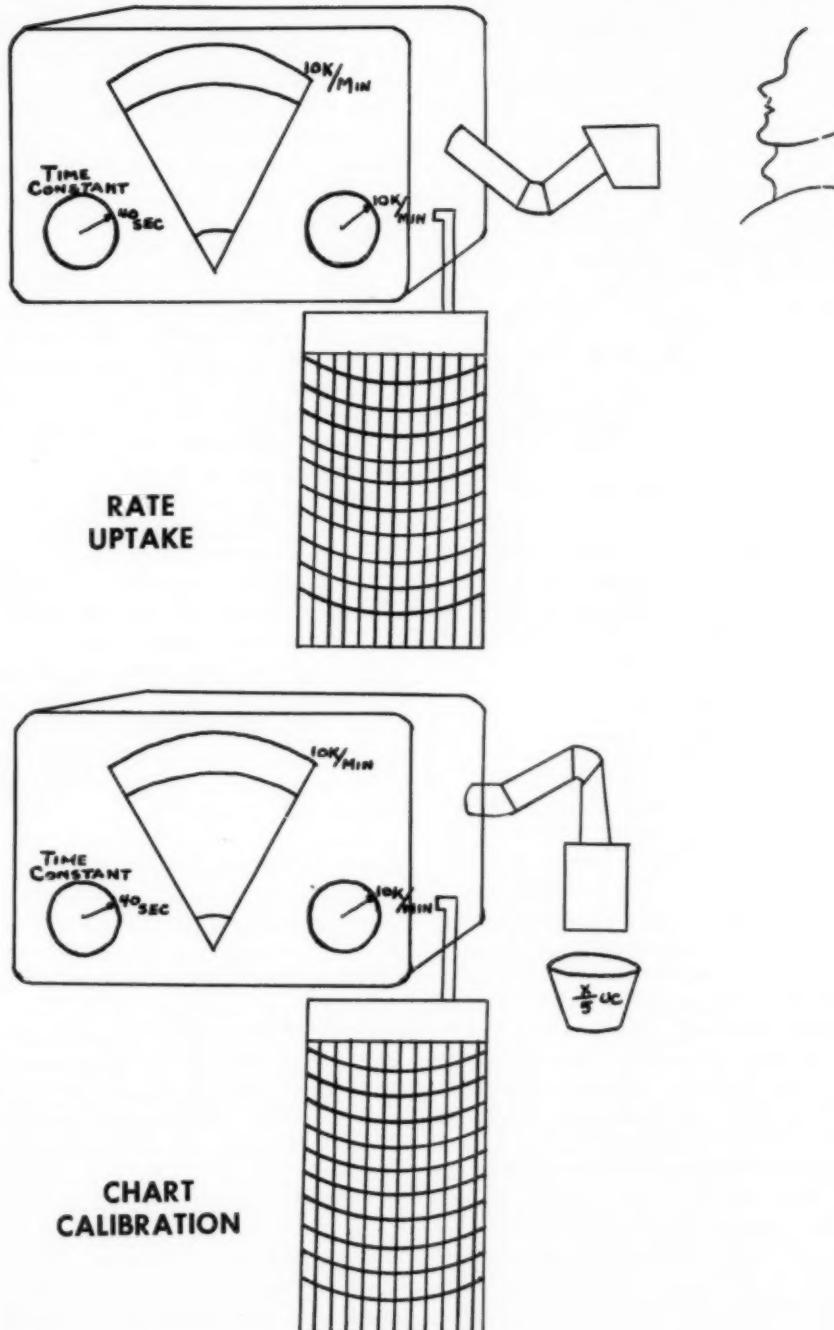


Fig. 2. Method B. Tracer dose μc . Chart calibration $\frac{x}{5} \mu\text{c}$.

IMMEDIATE UPTAKE CURVE	
24-HOUR UPTAKE TOTAL	HYPERTHYROID EUTHYROID
EUTHYROID/HYPERTHYROID →	97 10
→	8 269

TABLE I

scintillation tube positioned over it so that a full-scale deflection is obtained on a 10,000 count per minute scale. The scintillation tube is then placed at this distance from the neck of the patient, and the test is completed in the same manner as in Method A.

METHOD C

(Figure 3)

In the performance of Method C, a count rate meter having two scales with a ratio of 5 to 1 (500 and 100 counts per second or 30,000 and 6,000 counts per minute) is required. The tracer is placed in a container, preferably a wax cup, from which the patient will drink the dose after calibration has been attained. The scintillation counter is placed over the container at a distance which will produce a full-scale deflection in the 500 count per second scale. This distance is then measured. After the patient has consumed the tracer dose, the tube is positioned over the neck at the measured distance. The rate meter scale is then switched from the 500 to 100 count per second scale. With this new setting a full-scale deflection represents 20 per cent of the dose. The test is completed in the same fashion as in Method A.

RESULTS

In interpreting the slopes of the im-

mediate uptake curves, we regard a slope of 30 per cent or less to be in the euthyroid range, and a slope of 33 per cent or more to be in the hyperthyroid range. In the twenty-four-hour study, the range below 50 per cent is considered to represent euthyroidism, and above 55 per cent, hyperthyroidism. Borderline cases fall between these two figures.

Typical curves from immediate uptake tests are shown in Figures 4 and 5. Each division of the abscissa represents seven and one-half minutes, and each major division of the ordinate, 0.2 microcuries or 2 per cent of the tracer dose. The gradual rise of uptake in a normal person is shown in Figure 4, and the rapid rise in a hyperthyroid patient in Figure 5.

The findings in 389 patients, who underwent 516 combined immediate and twenty-four-hour uptake tests, were analyzed. This does not, however, represent the entire experience of this laboratory with thyroid uptake studies, since many patients did not receive the immediate uptake test.

In order to correlate the immediate readings with the twenty-four hour results, we have divided the examinations into several groups:

Group I. Initial studies on individuals not under the influence of iodine therapy or antithyroid drugs. In cases where such therapy had previously been given, the interval elapsing before the study was of sufficient length for the effects to have disappeared.

Group II. Studies on patients receiving iodine therapy or antithyroid drugs up to the day of the tests.

Group III. Studies on patients with hyperthyroidism following treatment with I^{131} .

Table I shows the results in Group I. There was agreement between the immediate and twenty-four-hour uptake tests in 366 of 384 studies (95 per cent). Disagreement was noted in 18 cases. In 8 of the latter, the results of the immediate test were in the hyperthyroid range, while the twenty-four-hour study indi-

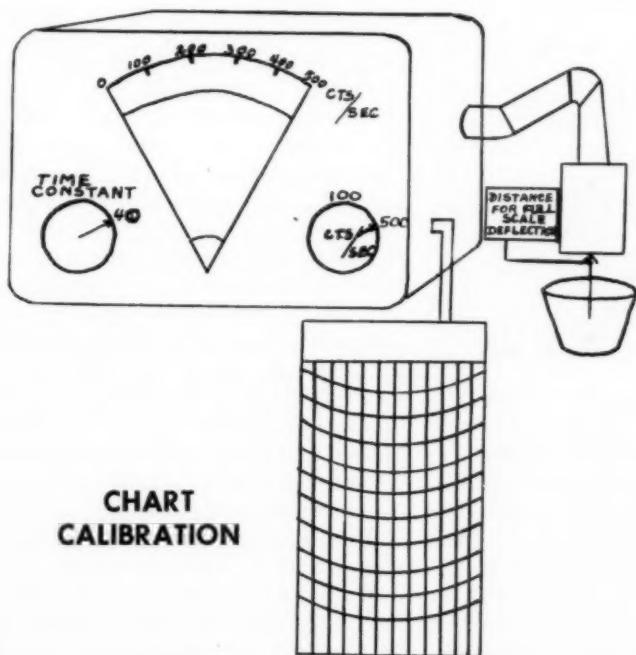
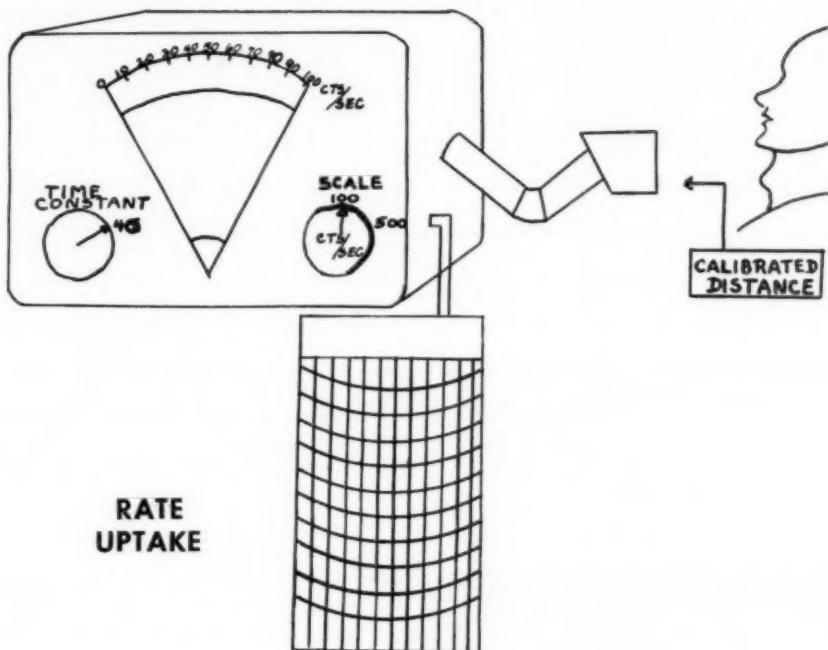


Fig. 3. Method C. Rate uptake scale, 100 counts per second. Chest calibration scale, 500 counts per second.

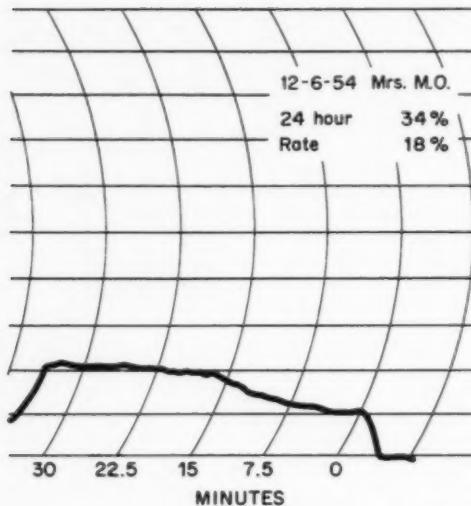


Fig. 4. Euthyroid slope.

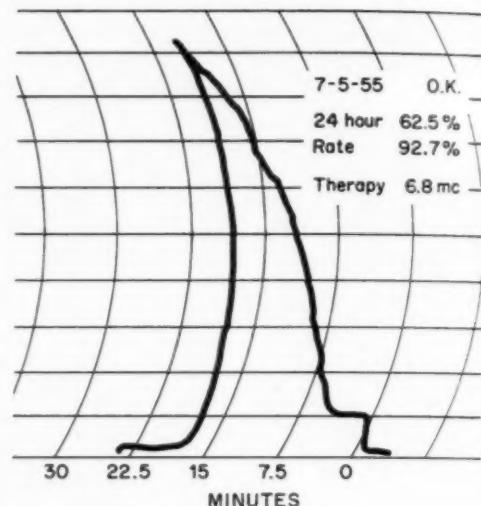
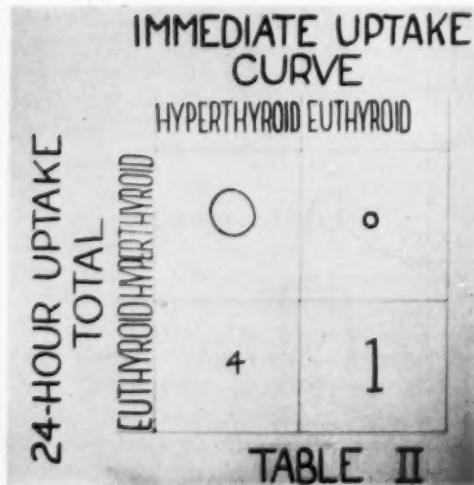


Fig. 5. Hyperthyroid slope.



cated euthyroidism. In 1 instance a toxic nodule (proved at surgery) may account for the difference in results. In the remaining 7 patients nothing was discovered which could be held responsible for the discrepancies; all showed varying mild symptoms of the type found in hyperthyroidism, but the presence of the condition was proved neither clinically nor by further laboratory procedures.

The other 10 patients whose tests were in disagreement were euthyroid according to the immediate reading and hyperthy-

roid by the twenty-four-hour test. It is of interest that 7 of these were cardiac patients with varying degrees of decompensation, which may account for the slow immediate uptake. We have no explanation for the differences in immediate and twenty-four-hour results in the other 3 patients.

Table II presents the results in Group II patients, who were receiving drug therapy at the time of the tests. In only 1 of the 5 patients in this group, all of whom were eventually found to have definite hyperthyroidism, was there a positive correlation between the immediate and the twenty-four-hour tests. In all the others, hyperthyroidism was indicated by the immediate test but not by the twenty-four hour test. Thus, in this small group of patients, the actual clinical condition of the thyroid was reflected more accurately in the immediate test than in the twenty-four-hour study.

Results in Group III, comprising 107 hyperthyroid patients tested after I^{131} therapy, are shown in Table III. Only the *first* tests done after therapy, most of which were performed after a two-month period, are included. Agreement between the two tests was observed in 96 of the 107 patients, or 90 per cent, all of whom

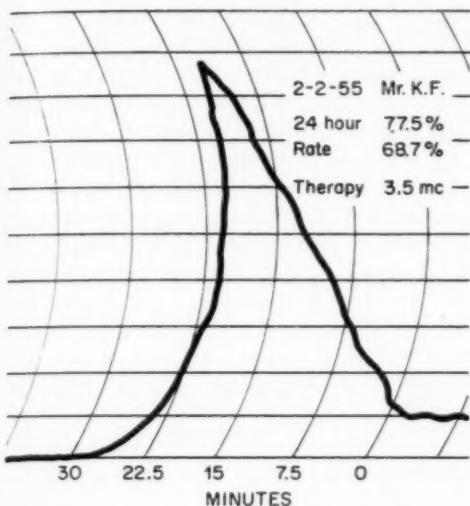


Fig. 6A. Hyperthyroid slope, before therapy.

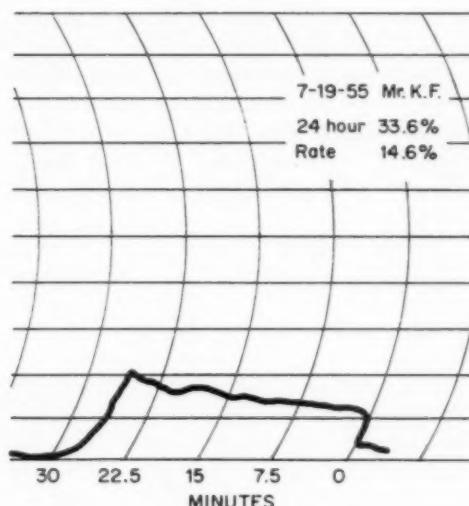


Fig. 6B. Euthyroid slope, after therapy.

were shown to be euthyroid. In 10 cases the immediate test showed hyperthyroidism and the twenty-four hour test euthyroidism. The situation was reversed in the remaining case. The eventual outcome of the 11 cases in which the tests were in disagreement is of interest: Two patients who were hyperthyroid according to the immediate test and euthyroid by the twenty-four-hour study were re-examined several months later, when both tests were found to be in the euthyroid range. Six patients with persistent, severe clinical evidence of hyperthyroidism were given additional treatment with I^{131} , with subsequent findings of euthyroidism in both the immediate and the twenty-four-hour test. Two patients, at later examinations, were found by both tests to have recurrent hyperthyroidism, with a return, also, of clinical evidence of the disease. They were retreated with I^{131} , and subsequently both tests showed them to be euthyroid. The one case in which there was a normal immediate uptake and a hyperthyroid twenty-four-hour uptake after I^{131} therapy has not been followed long enough for the eventual outcome to be determined. Figure 6 shows the immediate uptake curve before and after therapy.

IMMEDIATE UPTAKE CURVE	
HYPERTHYROID EUTHYROID	
24-HOUR UPTAKE TOTAL	
EUTHYROID/HYPERTHYROID	0 1
10	96

TABLE III

DISCUSSION

Certain objections to the method of performing the immediate uptake study may be raised. Since the scintillation counter is placed at a distance of only 9 cm. from the patient's neck, it may not "see" the entire thyroid gland. Such factors as poor positioning of the tube over the thyroid, the presence of aberrant thyroid tissue away from the neck, unequal activity in different parts of the gland, and asymmetrical location of residual gland

tissue after surgery may seem to invalidate the test, because of incomplete "seeing." Yet we have been unable to demonstrate inconsistency of results between the immediate uptake test and the twenty-four hour study in any instance in which one or more of the foregoing conditions was present.

Another objection may arise in connection with the effect of the presence or absence of food in the stomach on the immediate uptake curve. We have always performed the test without regard to this factor. Patients are permitted to eat before coming in for the examination. The high correlation of the results of the immediate uptake studies and the twenty-four-hour studies indicates that the influence of food in the stomach on the immediate test is negligible, since food, of course, does not appreciably affect the twenty-four-hour study. Patients with obvious clinical hyperthyroidism show an immediate rapid uptake of I^{131} regardless of food in the stomach. Immediate uptake tests have recently been performed on 5 fasting euthyroid individuals. The curves obtained differed in no significant respect from those obtained in other euthyroid patients who had not fasted.

CONCLUSIONS

The immediate I^{131} uptake study pro-

vides a rapid diagnostic method for differentiation of euthyroid from hyperthyroid patients. Routine performance of the test is simple, once the instruments have been calibrated. A high degree of correlation between this test and the twenty-four-hour uptake study was observed, except in cases of cardiac decompensation, in patients on antithyroid drug therapy or iodine, and in some hyperthyroid patients previously treated with I^{131} . It is possible that the immediate test is a more sensitive measure of thyroid activity than the twenty-four-hour study. It is considered, however, that this would be difficult to prove on the basis of the present data.

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SUMARIO

Estudios Inmediatos y Continuos de la Absorción de I^{131} en el Diagnóstico y el Tratamiento del Hipertiroidismo

Los AA. describen tres métodos para ejecutar una prueba rápida e inmediata de la absorción de I^{131} por el tiroides. Analizan los hallazgos en 389 enfermos, que se sometieron a 516 pruebas inmediatas y de veinticuatro horas combinadas de absor-

ción. Observóse una correlación elevada entre esta prueba y el estudio de absorción de veinticuatro horas, excepto en los casos de descompensación cardíaca, en los enfermos bajo terapéutica antitiroidea o yodo y en algunos sujetos tratados antes con I^{131} .

Es posible que la prueba inmediata represente una medida más delicada de la actividad tiroidea que el estudio de veinticuatro horas. No obstante, considérase que sería difícil demostrar esto a base de los datos actuales.

Según se observó, el estudio inmediato de la absorción de I^{131} suministró un rápido método diagnóstico para la diferenciación de los eutiroideos de los hipertiroides. Una vez calibrados los instrumentos, la ejecución corriente de la prueba es sen-

Physical Aspects of Megavolt Electron Therapy¹

K. A. WRIGHT, S.M., R. C. GRANKE, B.S., and J. G. TRUMP, D.Sc.

DIRECTED STREAMS of electrons with controllable energies in the 1- to 3-MEV range have been found uniquely suitable for the treatment of radiation-sensitive disease at the skin. This new approach to superficial therapy (1, 2) has been under investigation by members of the staff of the Lahey Clinic in Boston and the Massa-

variety of often difficult physical requirements. In the simplest case, the lesion may involve a single localized region of moderate size and superficial depth. Control by ionizing energy requires the delivery of an adequate dose and, if the lesion is malignant, the inclusion of an ample margin of healthy peripheral tissue. Such



Fig. 1. A. Rapidly growing epidermoid tumor near inner canthus at height of reaction one week after treatment with 2.5 MEV electrons. B. Response five weeks after electron therapy.

chusetts Institute of Technology during the four-year period commencing August 1951 (3). The present paper will report on the physical aspects of such megavolt electron therapy, including particularly the technics of electron irradiation of small and of extensive skin areas, the dose distribution below the skin, the reduction of accompanying whole-body x-irradiation, and the avoidance of possible accidental overexposure.

The effective treatment of radiation-sensitive lesions of the skin presents a

lesions can usually be controlled by conventional low-voltage x-ray therapy or by radioactive plaque technics. Only too commonly these lesions are adjacent to or overlie tissue structure whose tolerance for radiation is small. Figure 1A shows a typical rapidly growing epidermoid tumor near the inner canthus of the eye.

On the other hand, many superficial lesions are extensive and involve in varying degree all or nearly all of the skin. This is true of certain stages of mycosis fungoides, inflammatory carcinoma, psoriasis, atopic

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Fig. 2. A. Patient with extensive lesions of mycosis fungoides before electron therapy. B. Response three weeks after electron therapy.

dermatitis, and generalized exfoliative dermatitis. Such cases, except for palliation of the most troublesome areas, are often outside the capabilities of conventional x-ray therapy and still further beyond the more limited scope of the external radioactive plaque. Figure 2A shows a representative patient with advanced mycosis fungoides involving most of the skin surface. For such cases, the use of large fields of high-energy electrons may offer a uniquely effective method of treatment.

Analysis of the wide range of clinical manifestations of superficial disease has shown that most lesions can be effectively irradiated by electrons of constant but controllable energy directed at normal incidence into the skin surface. Such electron therapy offers the hitherto unattained possibility of both limiting the radiation dose to the actual depth of tissue requiring treatment and of reducing the reaction in

the radiosensitive skin. Moreover, monoenergetic electron sources can be arranged to irradiate either localized areas or, substantially, the entire skin surface, with short exposure times and with accurate control of the dosage. In most respects, as will be discussed, monoenergetic and normally incident electrons appear to possess the optimum physical properties for the radiation treatment of lesions near the skin.

DOSE DISTRIBUTION IN DEPTH

Much of the advantage of electrons for the therapy of superficial disease arises from the unusual subcutaneous maximum dose and from the absence of dosage beyond the electron range. Moreover, this localized dose can be adjusted to the depth of the lesion by controlling the voltage by which the electrons are accelerated. Figure 3 shows the relative dose distribution in

depth of water produced by 1.25-MEV, 2.5-MEV, and 5-MEV electrons (4). With electrons accelerated by constant voltage and directed normally into the skin, it is found that the region of greatest ionization occurs broadly at a depth of one-third the maximum range for electrons of that voltage. This subcutaneous maximum is often of great clinical advantage in reducing the reaction in the sensitive layers of the skin.

The maximum electron range, R_m , measured in millimeters of tissue of relative density δ is approximated by the relation

$$R_m = \frac{5V}{\delta} \text{ mm.}$$

where V is the energy of the impinging electron in millions of volts.

This equation indicates that the maximum range in water or material of 1 gram per c.c. is 5 mm. for 1,000,000-volt electrons and that it varies linearly with voltage and inversely with absorber density. Examination of the dose-in-depth curves of Figure 3 suggests that the effective biological range, R_{eff} , is about 0.6 R_m , the effective range being considered as the depth at which the ionization has diminished to about half its peak value.

It is of interest to recall the physical reasons for this build-up of ionization to a peak value below the skin surface. It is characteristic of all fundamental particles that the ionization density which they produce along a linear path in an absorber depends on the particle mass and the absorber density and remains substantially constant over a wide range of higher energies. As the energy of the particle becomes exhausted by inelastic excitation and ion-producing collisions, this linear ionization density increases; it reaches its maximum value just before the bombarding particle has been brought to rest. For relatively heavy undeviated nuclear particles such as protons and alphas, the typical Rutherford-Bragg distribution invariably shows peak ionization close to the end of their range. Electrons, however, because of their extremely low mass, are readily scattered in passing the atoms of the ab-

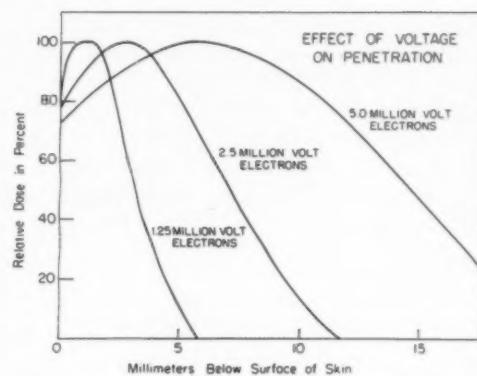


Fig. 3. Distribution of dose below skin produced by 1.25, 2.5, and 5.0 MEV electrons directed at normal incidence.

sorber. This scattering has the effect of broadening the zone of maximum ionization and of shifting it toward the surface. When the incident electrons are of essentially constant energy and directed perpendicularly into the surface, this broad maximum is centered at about one-third of the maximum range for that energy, thereby fortuitously favoring the radiosensitive skin layers, which receive a submaximum dose. Much of this advantage is lost if the incident electrons are accompanied by electrons of lower energies or if they approach the skin from scattered and tangential directions.

COMPARISON WITH X-RAYS AND BETA RAYS

Figure 4 shows the dose-in-depth distribution along the center axis of the beam of a typical beta-emitting plaque of strontium 90 in contact with the skin (5), of a gamma-emitting radium plaque 1 cm. from the skin, of 100-kv x-rays at 20 cm. target-skin distance, and of a beam of 2.5-MEV normally incident electrons from a constant-potential machine accelerator. It can be seen that only the monoenergetic electrons deliver their maximum dose subcutaneously. The beta-ray dose is maximum on the outer skin and falls off very rapidly below the surface because of both the wide spread of electron energies and the random directions which are characteristic of radioactive emission. The x-ray

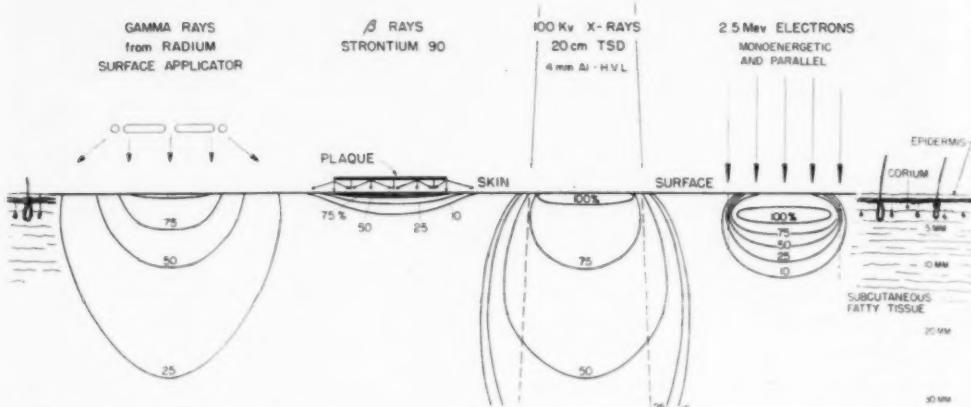


Fig. 4. Dose distribution below skin produced by gamma rays from a surface applicator, beta rays from contact plaque of strontium 90, 100 kv x-rays at 20 cm. T.S.D., and 2.5 MEV monoenergetic parallel electrons approaching perpendicularly.

beam likewise delivers its maximum dose to the skin, but with most of its energy passing on into underlying areas.

For a small lesion within a centimeter of the skin, the electron technic offers the more favorable dose distribution. Such lesions are nearly as effectively treated by the radium plaque and somewhat less so by the low-voltage x-ray beam. The latter two methods introduce progressively more irradiation of underlying healthy tissue. Even though some of the electrons from strontium 90 and its daughter yttrium have energies as high as 2.2 MEV, the average electron energy is only about 0.6 MEV. With all beta-emitting isotopes used in close external applicators the dose falls off with great rapidity and is generally effective only within a few millimeters of the surface.

IRRADIATION OF LARGE AREAS

The unique localization of electron doses to a tissue layer near the skin makes clinically feasible the irradiation of extensive areas—even the entire skin area—to adequate clinical dosage levels. It is likewise technically feasible to irradiate large skin areas uniformly and rapidly with megavolt electrons from certain machine sources.

It can readily be calculated that the delivery of an average dose of 1,000 rep to a depth of 5 mm. over a skin surface of 20,000 sq. cm. corresponds to a whole-body dose of 12 megagram rep, or to the absorption of about 1,000 million ergs of ionization energy including the accompanying x-radiation. With delivery over a period of two weeks, it would be expected that this total-body dose could readily be tolerated. Were this same superficial dose delivered by the 100-kv x-ray technic illustrated in Figure 4, the total-body dose absorbed by the patient would be about 70 megagram rep. Moreover, this sixfold larger dose would be maximum on the skin and would penetrate to many of the blood-forming organs. It is for these reasons that it has often been found clinically feasible to apply cathode-ray treatment to patients whose disease had progressed beyond the control of conventional x-rays.

The dose unit in this study is the rep and has been taken as corresponding to an energy absorption in soft tissue of 93 ergs per gram. Absorption in bone, although accompanied by increased electron scattering which affects local distribution, is at substantially the same rate in ergs per gram as in soft tissue for these high electron energies. Conversion to the rad, which refers to an energy absorption of

100 ergs per gram, can be accomplished by multiplying the rep dose by 0.93.

SOURCES OF MEGAVOLT ELECTRONS FOR THERAPY

The source of electrons used in this study was a constant-potential electrostatic generator of the Van de Graaff type insulated

a single traverse from head to foot, requiring about one minute, would deliver the desired daily dose of 200 rep to all the exposed upward looking skin. The posterior, lateral, and other surfaces would be treated in subsequent exposures with the patient in appropriately changed position. The eyes and skin surfaces not requiring treat-

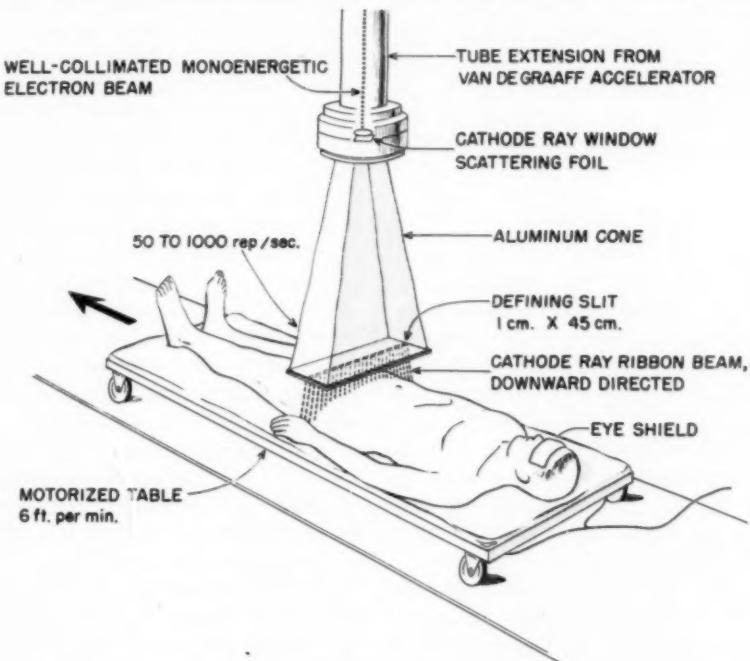


Fig. 5. Arrangement for treating extensive superficial lesions with high-energy electrons.

in compressed gas. The electron beam emerged into air from the evacuated acceleration tube through an aluminum window of 3 mil thickness.

In order to distribute a nearly uniform electron dose over large skin areas, the emerging beam was further scattered by an additional 15 mils of aluminum. This scattered electron beam was confined to an aluminum cone, the bottom of which was closed except for a slit 45 cm. long and 1 cm. wide. By passing the patient through the downward directed beam of electrons, any exposed skin could be treated. This was accomplished with the aid of a motorized table, as shown in Figure 5. The electron beam current was adjusted so that

ment were shielded with a sufficient thickness of cloth-covered metal, plywood, rubber, or some other low-atomic-numbered absorber. Involved eyelids and the region immediately adjacent to the eyes would be subsequently treated in a single exposure with lead-protective shields under the lids. It has not proved difficult to irradiate the entire skin surface with approximate dose uniformity when this was required.

In the electron therapy of mycosis fungoides, for example, two of the four large ports (either the anterior and posterior ports or the two lateral ports) would be treated to 200 rep entry, or 265 peak dose, on each day. Thus six treatment days

would be required to bring the entry dose level over the entire skin to 600 rep—the total dose commonly used in the initial treatment of this disease. Smaller or multiple fields would be treated similarly, with careful blocking off of the intervening regions. Single small fields, as in keloids or squamous-cell tumors, might receive fewer and larger doses. The patient shown in Figure 1 was given 1,200 rep on four occasions within a period of one week. The immediate and subsequent reactions to the electron treatment are illustrated in the figure. The response three weeks following 800 rep is shown in Figure 2B.

DOSAGE CONTROL

In all cases the electron dose was monitored and measured by reading continuously the entire beam current that emerged into the aluminum cone. The delivered dose through the slit to the skin had been previously measured in terms of this total electron current to the cone. Because of the electron scattering, this ratio of delivered to total-beam current is a function of voltage; in the present work this calibration was available for 1.5-, 2.0-, 2.5-, 3.0- and 3.5-MEV electrons.

In principle, the determination of electron dose is capable of great precision, since it depends solely on the number of electrons per square centimeter of absorber surface. The effect of voltage is merely to change the depth through which the typical dose distribution of Figure 3 is delivered.

It is important to remember the high inherent efficiency of electron therapy as contrasted with x-ray therapy. All the energy of the electrons incident on the patient is locally absorbed and is biologically effective. An electron charge of 10^{-9} coulombs—corresponding to a beam current of 10^{-3} microamperes for one second—delivered to 1 sq. cm. of skin produces an average dose of 300 rep over the effective range. In a typical electron treatment at 2.5 MEV, the total beam current emerging into the cone was 10 microamperes and the

current emerging through the slit toward the patient about 0.1 microampere.

REDUCTION OF ACCOMPANYING X-RAYS

At 2 MEV, less than 1 per cent of the electron energy reaching the patient is converted into x-rays. This component of whole-body x-irradiation which accompanies electron therapy is therefore extremely small; with 2-MEV electrons, the delivery of 1,000 rep to the entire skin of an average man would produce an average whole-body x-ray dose of about 5 r. The largest part of the x-radiation which reaches the patient is produced within the aluminum defining cone which intercepts most of the electron beam. This suggests the desirability of diminishing the proportion of cone-intercepted electrons and also of employing materials of low atomic number for the cone structure. When cones with narrow apertures are used, it may also be helpful to insert some lead absorber below the lower portions to intercept some of the high-energy x-rays close to their source. In the arrangement shown in Figure 5, these procedures made possible the delivery by electrons of 1,000 rep to the entire skin surface of a patient, with a whole-body x-ray dose of about 30 r. While this x-ray dosage appears sufficiently low to avoid excessive blood reactions, it seems entirely practical to diminish the amount still further by employing cones with wider slits and with internal surfaces of wood, Masonite, rubber, or plastic.

DANGERS OF OVER-EXPOSURE IN ELECTRON THERAPY

In electron beam therapy, as perhaps in no other type of radiation therapy, there exists the hazard of accidental over-exposure. This may be the result of operative factors, such as incorrect knowledge of the therapy beam current or of the time of administration; these are hardly different from the radiation hazards associated with other types of equipment. With machine sources of electrons, however, there is the additional possibility of

accidentally releasing a pulse of electrons during a transient discharge within the acceleration tube. Direct accelerators of the electrostatic or transformer types may discharge 10 per cent or more of the stored charge of the high-voltage terminal. Such a transient pulse could deliver in a few microseconds an electron dose up to one hundred times the therapeutic value. It is essential to recognize this potential hazard and provide means both to avoid such pulsed currents and to prevent their reaching the patient should they occur.

There are a number of ways to control the electron beam either magnetically or electrostatically so that electrons will emerge toward the patient only under conditions of normal voltage operation. These methods have the effect of switching off the electron beam early in development of a transient pulse so that little more than normal dosage can reach the skin of a patient. In the apparatus shown in Figure 5 this was done by focusing the electron beam with a short magnetic lens and passing it through a small hole in a thick diaphragm placed just below the aluminum window. An internal tube discharge causes an immediate drop in voltage, which in turn causes the beam both to become over-focused and to shift its position, thereby greatly diminishing the electron dose which can pass through the hole toward the patient.

POSSIBILITY OF APPARATUS OF REDUCED SIZE

A 1.5-MEV electrostatic accelerator contained in a tank of 30 in. diameter and 60 in. length is now being modified at the Massachusetts Institute of Technology to provide a compact source of megavolt electrons for superficial therapy. This apparatus will provide electrons of controlled energy from 0.75 to 1.5 MEV over a nearly uniformly illuminated field of 30 × 60 cm. aperture. This large field will permit the stationary treatment of large skin areas and can also be adapted to whole skin treatments by moving or rotating the patient as before. Small fields can be

treated by blocking off the aperture with a suitable thickness of Masonite or other absorber. This apparatus represents a very considerable increase in compactness and flexibility over the present experimental unit, but its use will be limited to lesions lying within 5 mm. of the outer skin surface. It will therefore prove inadequate for some of the deeper lesions that have occasionally been encountered. Even with 3-MEV electrons, however, lesions beyond the range of such electrons have been an occasional problem. These cases were often solved by the supplementary use of 2-MEV x-rays, usually approaching the lesion tangentially.

CLINICAL OBSERVATIONS

In the past four years under the medical supervision of members of the staff of the Lahey Clinic about 150 patients with superficial disease have been treated with megavolt electrons; 60 of the cases were mycosis fungoides, often involving the entire skin surface. In many of these the capabilities of conventional therapy had been exhausted; yet the response to electron therapy was dramatic. In general, no lesion within 1 cm. of the skin has been encountered for which treatment with electrons has not been found to be technically feasible.

Careful observations are being made of the response of normal, abnormal, and malignant tissue to controlled doses of megavolt electrons and of the systemic and hemopoietic reaction to large field irradiation. These clinical studies are still in an early stage and only preliminary reports have thus far been made (6, 7).

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SUMARIO

Aspectos Físicos de la Electronoterapia con Megavoltios

Las corrientes dirigidas de electrones de energías graduables en la escala de 1 a 3 MEV han resultado ser únicas en su adecuación para el tratamiento de las lesiones radiosensibles de la piel. Esta electronoterapia ofrece la posibilidad inalcanzada hasta ahora de limitar la dosis de radiación a la exacta profundidad del tejido que requiere tratamiento y a la par de reducir la reacción en la piel radiosensible. Además, pueden disponerse focos monoenérgicos de electrones de modo que irradién ya zonas localizadas o toda la superficie cutánea con tiempos breves de exposición y gobierno exacto de la dosis.

Gran parte de la ventaja de esta modalidad terapéutica proviene de la excepcio-

nal dosis máxima subcutánea, de la falta de dosificación más allá de la escala de los electrones y de la posibilidad de ajustar la dosis localizada a la profundidad de la lesión.

Discútese la técnica, incluso las medidas destinadas a reducir la irradiación X concomitante y a evitar la sobreexposición fortuita.

Agrégase una presentación preliminar de los resultados obtenidos en 150 enfermos tratados en los últimos cuatro años. Entre ellos figuraban 60 casos de micosis fungoidea. En general, no se encontró ninguna lesión que quedase dentro de 1 cm. de la piel en la que no resultara factible la electronoterapia.

DISCUSSION

J. Robert Andrews, M.D. (National Cancer Institute): I can not, like Dr. Trump, report on work done but only on work that you might say is in progress. I report also as a student of Dr. Trump because the group with which I am associated has called on him freely for help and advice throughout our planning and he has given it equally freely.

At the National Cancer Institute there are two Van de Graaff accelerators of 2,000,000 volts maximum energy. Each has a retractable target so that the electron stream can be removed as a useful beam. We have adapted these machines very much as Dr. Trump has described, by providing scattering material of thin aluminum foil just beyond the tube window and confining the beam by a plywood cone forming a field about 30 × 30 cm. at a distance of some 125 cm. We do not employ a moving transport device for the patient, but we have used instead a multiple fixed beam technic which, present studies would indicate, has allowed homogeneous irradiation by appropriate selection of fields and application at various angles of incidence around the body.

Because of technical difficulties, some of which have been described by Dr. Trump, we have operated by choice only to a maximum of 1.5 MEV and, as a result of this and the difference in the scattering and beam-shaping method, we have found that our maximum dose is apparently at or very near the surface rather than beneath the surface. This presumably is due largely to the scattered component reaching the skin surface from the walls of the plywood cone. We hope to correct this in order to take advantage of the better distribution of ionization as described by Dr. Trump. Despite this variation, our experience suggests that we are obtaining effective radiation.

Inasmuch as this work is just commencing and the number of patients treated has been very few, I cannot report on long-term clinical results. By way simply of describing work in progress, I may say that the immediate results are favorable.

John Hale, M.S. (University of Pennsylvania): I would like to comment on one point in Dr. Trump's fine paper. In the figure which com-

pares the depth dose characteristics of various radiation sources with those of the electron beam, the type of x-ray equipment chosen is what I would call an intermediate voltage machine—operating in the 100-kv region with moderate added filtration.

I think it would have been interesting to clinicians to have included the characteristics of the low-voltage, low-inherent-filtration beryllium-window x-ray tubes. These machines are small and flexible. Good depth dose data are available, mainly due to Jennings (Brit. J. Radiol. Supplement No. 5). Measurements show that such tubes, with 1.0 mm. beryllium inherent filtration and operating in the 40- to 50-kv region, give a depth for 50 per cent of skin dose at about 1 mm. The depth for 10 per cent of skin dose is about 5 mm.

J. G. Trump, D.Sc. (closing): I appreciate Dr. Andrews' generous remarks and am keenly interested in what his group is doing with high-energy electrons as well as with x-rays. It will be of real

value to learn the results of their careful, systematic delivery of somewhat higher electron doses to patients with mycosis fungoides.

The last speaker suggested the use of unfiltered roentgen radiation with the voltage adjusted to fit the depth of the superficial lesion. This can be done, and there is lots of room for ingenuity in choosing the right voltage and filter to give the distribution needed for particular tumor problems. At low voltages and with unfiltered radiation, the distribution-in-depth is suitable for very superficial lesions. Suppose, however, that the problem requires the treatment of a lesion 5 mm. thick. Then low voltage and unfiltered radiation would be undesirable, and higher voltages with filter would reach the 5-mm. depth but deliver most of the energy in the beam to the normal tissue beyond.

In general, while adjustment of x-ray voltage and filtration to the tumor depth is helpful, it cannot achieve the favorable localization which is obtainable with directed electrons of controlled energy.



Invagination of the Esophagus in Hiatus Hernia¹

EDMUND W. KLINEFELTER, M.D.

THE SYMPTOMS in hiatus hernia, especially dysphagia, may sometimes be produced by invagination of the esophagus within the hernia. While this condition is not uncommon, and is of considerable roentgenologic significance, it often goes unrecognized, as a result partly of the intermittent and evanescent character of the invagination and partly of inadequate roentgen examination of the esophagogastric region. A search of the literature revealed only 11 cases, all in foreign-language publications. A review of such well known radiologic and gastroenterologic texts as those by Schinz (13), Golden (4), Shanks (12), Assmann (1), Teschendorf (15), Bockus (2), and Henning (5) disclosed no information on the subject.

In view of the importance to the roentgenologist of esophageal invagination in association with hiatus hernia, and because of the lack of available information on the subject, 3 representative cases are presented.

CASE REPORTS

CASE I: On Dec. 17, 1948, during the course of a heavy meal, C. S., a 57-year-old white housewife with no previous record of serious illness, experienced moderate dysphagia, with a sense of pressure high in the epigastrium behind the xiphisternum. Immediately afterward, she reclined for a short time but, since this seemed to increase the epigastric discomfort, she proceeded with her household duties and the symptoms disappeared. She attributed her difficulty to a change of diet incident to a recent trip and the shock of witnessing a serious automobile accident.

The symptoms recurred intermittently over a period of five days, and on Dec. 22 the patient consulted her physician. At that time, physical examination disclosed nothing of note other than slight tenderness high in the epigastrium. Electrocardiographic and blood and urine studies were negative. The stools showed no evidence of blood. A barium-meal examination on Dec. 28, when the patient was symptom-free, disclosed nothing of interest other than a small sliding hiatus hernia. Barium-enema and gallbladder examinations were negative. Bella-

donna, phenobarbital, and a bland diet produced no improvement, and after a week the patient was referred to a surgeon, who advised surgery for the hernia. This she refused.

A second barium-meal examination was made on Jan. 12, 1949, while symptoms were present. In addition to the hiatus hernia, films made in the horizontal position now showed a complete invagination of the esophagus through the center of the hernia, with the head of the invagination terminating below the diaphragm (Fig. 1). On fluoroscopy, as the patient was elevated from the horizontal to the vertical position, the herniated stomach could be seen to slip away from the esophagus at 40° to 60°, disappearing completely beneath the diaphragm by the time the vertical position was reached, leaving the esophagogastric region normal in appearance. As the patient was again lowered, at between 60° and 40° the fundus of the stomach started to protrude through the hiatus, invaginating the esophagus in its center, so that by the time the horizontal position was reached, invagination was complete. This change in position was repeated five times during fluoroscopy, and each time invagination occurred in the horizontal position, and disinversion in the vertical position. At no time was it possible by positioning, by sudden release of abdominal pressure, or by Müller's or Valsalva's maneuver to disinvaginate the esophagus when the patient was recumbent. With the exception of this invagination, the examination disclosed nothing of significance.

The attending physician advised six small, non-bulky meals daily instead of three, maintenance of an upright posture after eating, and avoidance of heavy lifting and stopping. Belladonna and phenobarbital were prescribed. After three weeks, the symptoms disappeared, and an esophagoscopic examination on Feb. 25, 1949, was negative. The patient has had no further complaints. A barium-meal examination on July 10, 1954, showed no evidence of invagination. A small hiatus hernia, similar to that present at the original examination (Dec. 22, 1948), was still noted; otherwise the findings were normal (Fig. 2).

CASE II: On Sept. 3, 1944, P. M., a 54-year-old white woman, was referred for a barium-meal examination because of slight dysphagia and epigastric discomfort experienced intermittently over the past five weeks. The epigastric discomfort was increased by eating and by lying down after meals. Otherwise, there were no complaints. Physical examination and laboratory studies, including tests for blood in the stool, were negative. Prior to her present discomfort, the patient had never had any serious illness.

The barium-meal examination, performed when

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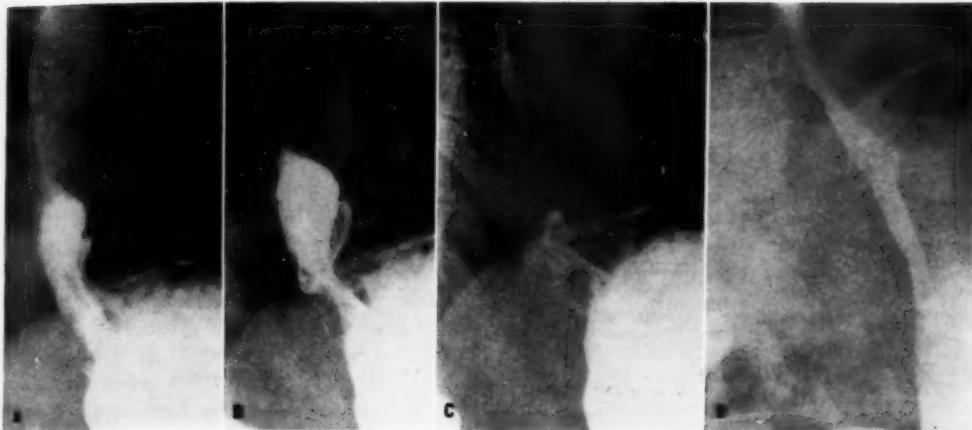


Fig. 1. Case I. Barium-meal examination on Jan. 12, 1949, illustrating change in appearance with change in position of the patient, from 20° Trendelenburg to vertical, during invagination and disinversion of the esophagus. All radiographs were taken in the left posterior oblique projection. Manual pressure was employed for films A, B, and C.

A. At 20° Trendelenburg the stomach has herniated through the hiatus to form the intussusceptum or sheath. Gastric rugae are well visualized as they traverse the hiatus. The rugae of the invaginated esophagus have not yet been visualized. Barium, however, has collected in the esophagus at the superior portion of the herniated stomach, producing the appearance of a congenital short esophagus, as described by Malenchini and Resano (7).

B. At 20° toward the vertical, the herniated stomach, visualized by a veil-like coating of barium, has receded somewhat beneath the diaphragm. Note the characteristic funnel-shaped depression in the superior portion of the herniated stomach produced by the invaginated esophagus. The fine rugae of the esophagus are now seen passing through the center of the hernia. Thus, the appearance of the invaginated esophagus in the hiatus hernia often resembles a Jack-in-the-pulpit.

C. At 40° toward the vertical, the herniated stomach has receded further beneath the diaphragm, with the funnel-shaped depression in the superior portion becoming considerably less conspicuous. The fine rugae of the invaginated esophagus are still evident in the center of the faintly outlined herniated stomach.

D. In the vertical position, the herniated stomach has receded completely beneath the diaphragm, thus reducing the invagination and hernia simultaneously, and restoring to the esophagogastric region a normal appearance.

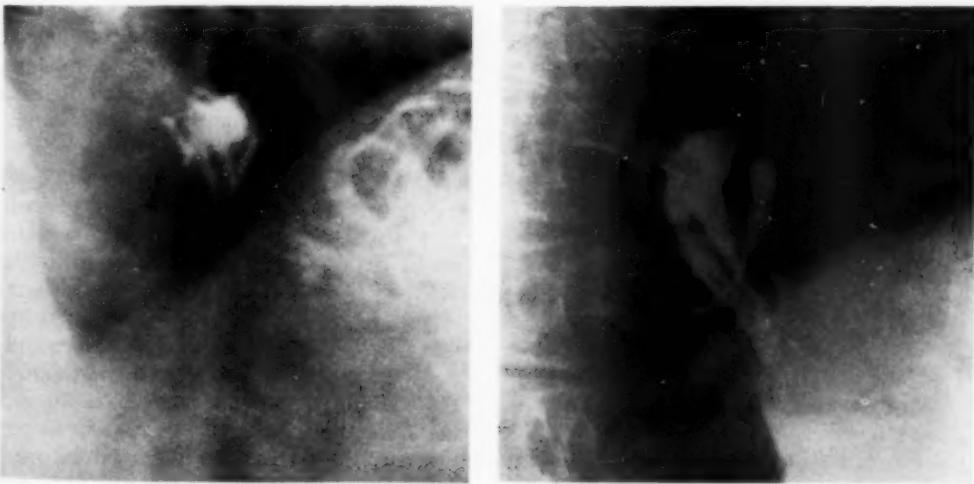


Fig. 2 (left). Case I. Barium-meal study, July 19, 1954, revealing only a small symptomless sliding hiatus hernia, with no evidence of an invaginated esophagus.

Fig. 3 (right). Case II. Jack-in-the-pulpit appearance of invagination of the esophagus through the center of a hiatus hernia, showing the characteristic funnel-shaped depression in the superior portion of the herniated stomach. The appearance is similar to that in Fig. 1B. Radiograph taken during performance of Valsalva's maneuver with the patient supine.

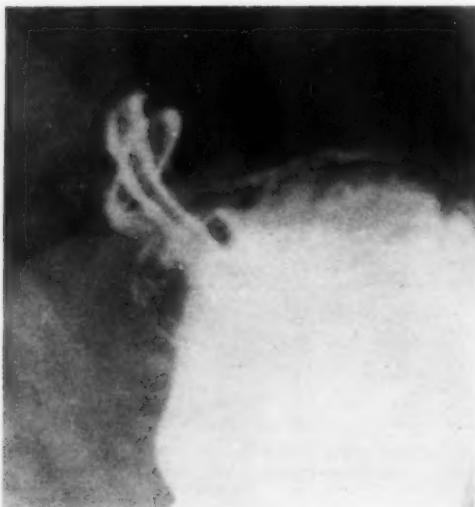


Fig. 4. Case III. Jack-in-the-pulpit appearance of invagination of the esophagus in hiatus hernia. The rugae of the invaginated esophagus are clearly apparent through the veil-like coating of barium in the herniated stomach. Radiograph taken in the horizontal left posterior oblique position as the patient drew in the abdomen.

symptoms were evident, showed findings almost identical with those in Case I (Fig. 3). Similar treatment was instituted, and the patient became symptom-free within a period of four weeks. An esophagoscopy examination on Nov. 5 was negative. The only finding of significance on a barium-meal study two years later was a small hiatus hernia.

CASE III: On Jan. 3, 1952, R. W., a 51-year-old white draftsman, was referred for a barium-meal study as part of a general physical check-up. He had no complaints prior to or at that time, nor had he suffered any serious illness in the past. The roentgenologic examination of the esophagogastric region disclosed an invaginated esophagus similar to that seen in Case I (Fig. 4). An esophagoscopy study done on March 12 was negative. Barium-meal re-examination after a lapse of one year, during which time the patient remained without symptoms, revealed only a small hiatus hernia.

ETIOLOGY

Why the upward protruding stomach in hiatus hernia should at one time displace the esophagus upward and at another time ensheathe it is in most instances difficult to explain. Tumor, esophagitis, ulcer, adhesions, or disordered motor function, with one possible exception, were not mentioned in the cases reported above. Sarasin (11)

attributed these invaginations to excessive length of the esophagus. But Poirer and Poirer (8) believed that some explanation other than simple elongation was necessary. Malenchini and Resano (7), and Hilscher (6) advanced no opinions concerning etiology. In the 3 cases above no definite etiology was noted, though in Case I the change in diet and emotional disturbance incident to witnessing a serious accident may have incited sufficient motor dysfunction and irregular peristalsis to be of significance.

PATHOLOGY

The esophageal invaginations may vary in extent from a slight prolapse of the mucosa to complete excursion of the esophagus through the hernia. They may occur in hernias of any size but are more frequent in the smaller ones. Strangulation, with rapidly following hemorrhagic infarction, gangrene, and perforation, common in the well known invaginations at the ileocecal valve, has not been reported. If esophageal obstruction was present, it was usually not marked.

In 2 of the cases from the literature, surgical exploration was performed. In 1, adhesions and a broad, short, indurated gastrohepatic ligament were found about the abdominal course of the esophagus. Roentgenologically, the lower esophagus, in this case, showed thick mucosal folds, while the esophagoscopy examination revealed an edematous mucosa, with a polypoid appearance such as may result from esophagitis (9). In the second case, surgery disclosed only the presence of a hiatus hernia (7). There was no mention of esophagitis in any of the other reported cases. In the present group esophagitis was evident neither roentgenologically nor esophagoscopically. Roentgen study showed the esophagus to be flexible, with the mucosal folds in the invaginated portion apparently normal in width and regular in contour.

SYMPTOMS

When there is considerable invagination of the esophagus into an asymptomatic

hiatus hernia, symptoms are to be expected in the majority of cases. When disinvagination occurs, the hernia tends to become symptomless.

Dysphagia, usually of mild or moderate degree, is the most frequent symptom. It is found in more than 50 per cent of cases of invagination, as compared with 8 per cent of cases of uncomplicated hernia (3). Pain, in the form of pressure or discomfort behind the xiphisternum, is next in frequency. Coming on during or after meals, it is usually not severe; it may at times radiate to the back. Tenderness to palpation high in the epigastrium may be present. Symptoms observed in uncomplicated hernia, as nausea, vomiting, belching, palpitation, anginal pain, dyspnea, and cough have not been noted with these invaginations. Hurried eating of large bulky meals usually aggravates the discomfort, while slow eating of small non-bulky meals often serves to prevent it. At times, postprandial discomfort may be relieved when the patient assumes a standing posture, or may be increased on lying down. The symptoms tend to be intermittent and non-progressive. Sarasin and Hoch (10) state that in some instances hemorrhage may occur, although no mention of this was found in any of the 11 cases reported in the literature, nor was it observed in the present series. Finally, it should be emphasized that in none of these cases were there severe symptoms comparable to those which usually result from invagination at the ileocecal valve.

DIAGNOSIS

When a patient with a hiatus hernia complains of dysphagia, a careful roentgenologic study should always be made for esophageal invagination. First, it should be borne in mind that when the roentgen examination is performed in the upright position only, the greater number of these invaginations will be overlooked. This is due to the fact that they occur, for the most part, in sliding hernias, in which both hernia and invagination undergo reduction in changing from the horizontal to the erect

posture. When the horizontal position is resumed, hernia and invagination reappear. Since invagination is more apt to be present when symptoms are experienced, it is important to perform the examinations at such times, as exemplified by Case I.

Best results will usually be obtained when the patient is examined fluoroscopically in the horizontal or Trendelenburg left posterior oblique position. The stomach should be filled with thin barium, and sufficient thick barium should be swallowed during the examination for good spot films to be obtained. Occasionally, the invagination is more readily visualized with the hips elevated by a pillow. Manual pressure on the epigastrium, having the patient draw in the abdomen, or performance of Müller's or Valsalva's maneuver, may sometimes be of assistance.

By proper positioning and application of pressure, it will be possible in practically all cases for the examiner to displace sufficient thin barium from the portion of the stomach below the diaphragm into the herniated portion, so as to line it with a veil-like coating, through which the mucosal folds of the ensheathed esophagus can be visualized as the patient swallows the thick barium. Frequently in roentgen examination of the esophagogastric region, dependence is placed wholly on the supine position and on reflux of barium from the stomach into the esophagus. It should be emphasized that this procedure is inadequate in most cases, and the roentgenologist who relies on it solely will overlook or misdiagnose the large majority of these invaginations.

In addition to the examination made in the horizontal or Trendelenburg position, the region should be studied fluoroscopically and with spot films as the patient is elevated from the horizontal toward the vertical to demonstrate the process of disinvagination.

DIFFERENTIAL DIAGNOSIS

When the esophagogastric region is studied in the manner recommended, with

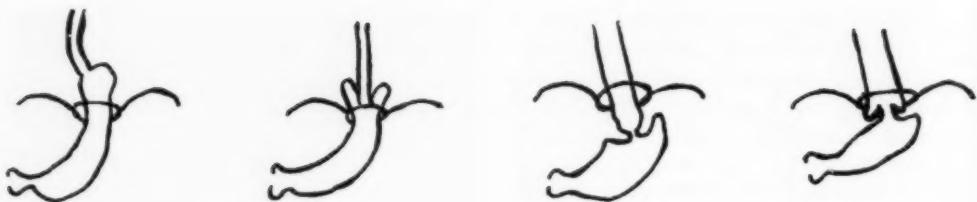


Fig. 5. Hiatus hernia and the three types of associated esophageal invagination.

- A. Hiatus hernia with upward displaced esophagus. In this, the commonest type of hiatus hernia, the esophagus appears too long. Most of these hernias are small, sliding, and symptomless, with invagination of the esophagus occurring not infrequently.
- B. Invagination of the esophagus into a sliding hiatus hernia. These invaginations tend to disappear spontaneously, while the hernias tend to persist. Disinvagination of the esophagus and reduction of the hernia occur regularly as the position is changed from the horizontal to the upright. Symptoms may be expected in the majority of cases where there is considerable invagination.
- C. Rare invagination of an elongated and dilated esophagus, with contracted cardia, into the stomach beneath the diaphragm. The esophagus has herniated downward through the hiatus.
- D. Rare invagination of the stomach into an elongated and dilated esophagus, with dilated cardia. The esophagus has herniated downward through the hiatus.

good relief films during invagination and disinvagination in horizontal, semi-horizontal, and vertical positions, it becomes practically impossible to confuse this condition with any other, such as congenital short esophagus, esophagitis, ulcer, diverticulum, varices, or tumor. An example of the importance of studying the esophago-gastric region as directed here, is furnished by the case reported by Malenchini and Resano (7). In this instance, insufficient study indicated what appeared to be a congenitally short esophagus. With more extensive examination, the true nature of the condition, invagination of the esophagus in hiatus hernia, was recognized. Figure 1A from Case I of the present series shows the appearance described by these authors.

Differentiation of the other two types of invagination occurring in hernias in the distal esophagus from the invaginations in hiatus hernia should cause little difficulty. Both of the former are found much less frequently; in both, the esophagus is dilated and the hernia is subdiaphragmatic. In one, the cardia is contracted and the esophagus invaginates into the stomach (6); in the other, the cardia is dilated and the stomach invaginates into the esophagus (14). In Figure 5 are shown the essential features of the common hiatus hernia and the three types of invagination.

TREATMENT

Since invaginations of the esophagus in hiatus hernias tend to undergo spontaneous reduction, and since the symptoms which they produce are usually mild, prompt surgical interference, such as is necessary for invaginations at the ileocecal valve, will rarely be required. In fact, surgery should not be performed for a hiatus hernia in which dysphagia is the chief symptom until a possible complicating invagination of the esophagus has been ruled out. If such an invagination is found, there is considerable likelihood that it will disappear spontaneously or under conservative treatment.

In the presence of symptoms, the most important single factor in treatment is avoidance of overloading of the upper gastrointestinal tract with food. Six small non-bulky meals should be taken daily instead of three. Food should be thoroughly chewed and eaten slowly. The second most important factor is avoidance of increase of intra-abdominal pressure, such as may result from constipation, heavy lifting, or stooping. Maintenance of the upright posture after meals may at times be of benefit. Occasionally, sedative and relaxing drugs, such as phenobarbital and belladonna, afford some relief. Most patients, just as those in the present study, may be satisfactorily treated by these

measures. In a few cases, however, if the symptoms become unbearable or there is serious bleeding, surgical repair of the hernia, which automatically removes the possibility of invagination, must be considered.

SUMMARY

1. Symptoms in hiatus hernia, especially dysphagia, may be due to unrecognized invagination of the esophagus within the hernia.

2. Strangulation, with rapidly following hemorrhagic infarction and subsequent gangrene and perforation, a usual finding in invaginations at the ileocecal valve, has not been observed in the esophageal invaginations.

3. Dysphagia is the most common symptom. It occurs in more than 50 per cent of the cases of invagination, as compared with 8 per cent of cases of uncomplicated hernia.

4. When a patient with a hiatus hernia complains of dysphagia, a careful roentgenologic study should always be made for an invaginated esophagus.

5. Diagnosis depends upon adequate study of the esophagogastric region by fluoroscopy and spot films made during invagination and disinvagination, with the patient in horizontal, semi-horizontal, and vertical positions.

6. Since invaginations in hiatus hernia tend to undergo spontaneous reduction, and since the symptoms produced are usually mild, prompt surgical interference, such as is necessary for invaginations at the ileocecal valve, will rarely be required.

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SUMARIO

Invaginación del Esófago en la Hernia Hiatal

Presentan 3 casos de invaginación del esófago en la hernia hiatal, con una discusión de los síntomas de la enfermedad, la posible etiología, la anatomía patológica, los problemas del diagnóstico y la terapéutica. En ninguno de los casos del A. observaron los graves síntomas que son

comunes en la invaginación en la válvula ileocecal.

El síntoma más frecuente es la disfagia, y su existencia unida a la hernia hiatal impone un cuidadoso estudio roentgenológico, comprendiendo fluoroscopia y radiografías instantáneas, tomadas durante la invagina-

ción y la desinvaginación, con el enfermo en las posiciones horizontal, semihorizontal y vertical. El examen debe ser ejecutado cuando los síntomas son manifiestos. Recállase la importancia de la posición apropiada, es improbable que se descubra el estado cuando se lleva a cabo el estudio con el enfermo únicamente en la posición vertical, dado que la invaginación tiene lugar generalmente en las hernias de desliza-

miento, en las que tanto la hernia como la invaginación experimentan reducción en una desviación de la posición horizontal a la erecta.

Como la invaginación en la hernia por el hiato suele desaparecer espontáneamente y como los síntomas concomitantes suelen ser leves, rara vez se necesita la rápida intervención cruenta. La dieta y los sedantes pueden ayudar en el tratamiento.



Volvulus of the Entire Small Bowel in the Immediate Postoperative Period

WILLIAM E. GANNON, M.D., and LEO A. HARRINGTON, M.D.

VOLVULUS OF THE small intestine accounts for about 5 per cent of the total cases of intestinal obstruction (1). Volvulus of the entire small intestine (from the ligament of Treitz to approximately the terminal ileum) is, however, a comparatively rare entity. McKechnie and Priestley (2) found only 3 examples among 37 cases of volvulus of the small bowel seen over a period of twenty-five years at the Mayo Clinic. In 1934 Gardner and Hart (3) collected 88 cases of volvulus of the entire small bowel. McIntosh and Donovan (4) added 20 cases in 1939. Most of the patients have been children, and congenital abnormalities were usually responsible for the volvulus. In adults the condition is usually the result of postoperative adhesions. A small number of cases, however, occurring in the immediate postoperative period cannot be explained on this basis. McKechnie and Priestley mention 2 examples of this type but do not state the amount of bowel involved. Turner and Sloan (5) report a case in a twenty-eight-year-old white woman following exploration for an unruptured tubal pregnancy. On the sixth postoperative day she was re-explored, and the small bowel from a point just distal to the ligament of Treitz to within 18 inches of the ileocecal valve was found to be twisted 360 degrees. These authors found 2 other cases of lesser extent in the records of the Presbyterian Hospital, New York. The present report records an additional case, with a pre-operative gastrointestinal study.

CASE REPORT

A. P., a 30-year-old white female, entered Kings County Hospital on Nov. 20, 1954. She had been admitted to another hospital on Nov. 4 for a skin graft to the right leg and, while there, showed signs of acute appendicitis. A laparotomy was performed

through a McBurney incision on Nov. 6, and the appendix proved to be normal. Palpation of the contents of the peritoneal cavity revealed nothing remarkable, and a diagnosis of acute pancreatitis was made. The appendix was removed.

The operative procedure was tolerated well, but the next day the patient went into shock and several pints of blood were administered. Following recovery from shock, on the second postoperative day, abdominal distention and an epigastric mass were noted. A Miller-Abbott tube was passed and decompression was effected. On the next day a loose bowel movement occurred, with the passage of "dark clots of blood" and a decrease in the epigastric mass. On the fourth postoperative day jaundice was first noted and the patient had an episode of "toxic psychosis," from which she recovered spontaneously. On the fifth day she was out of bed and began to eat. Her condition improved steadily until the eighth postoperative day, when distention again occurred, with severe cramps and epigastric pain which came on immediately after eating. This condition continued for five days. During this period the patient was eating and having regular bowel movements, following which the pain consistently diminished.

On the night of Nov. 19 the pain became extremely severe and the patient could not be quieted. She was thought to have an acute psychosis and was transferred to the psychiatric ward of another hospital. The following day she was brought to Kings County Hospital. Physical examination upon admission revealed a well oriented, co-operative, fairly alert young woman, who appeared quite toxic.

The sclerae and conjunctivae were icteric. The mucosa of the mouth and pharynx revealed marked dehydration. There were moist râles at the right lung base. The cardiac rhythm was regular and the heart was not enlarged. There was a tachycardia of 140/min. The liver was three finger-breadths below the costal margin. The abdomen was distended and bowel sounds were diminished. There was no costovertebral angle tenderness. The erythrocyte sedimentation rate was 18 mm. in 60 min.; hemoglobin 11 gm. per cent; icteric index 29; white blood count 20,400 with 84 per cent polymorphonuclears; serum amylase 352 Somogyi units. In view of this last finding the patient was considered to have acute pancreatitis and was treated accordingly. Under this regimen she improved gradually. Icterus disappeared, and she became fairly comfortable except for occasional bouts of epigastric pain.

¹ From the Department of Radiology and Surgery of the Kings County Hospital, Brooklyn, N. Y. W. E. G., Resident in Radiology; L. A. H., Director of Radiology. Accepted for publication in November 1955.

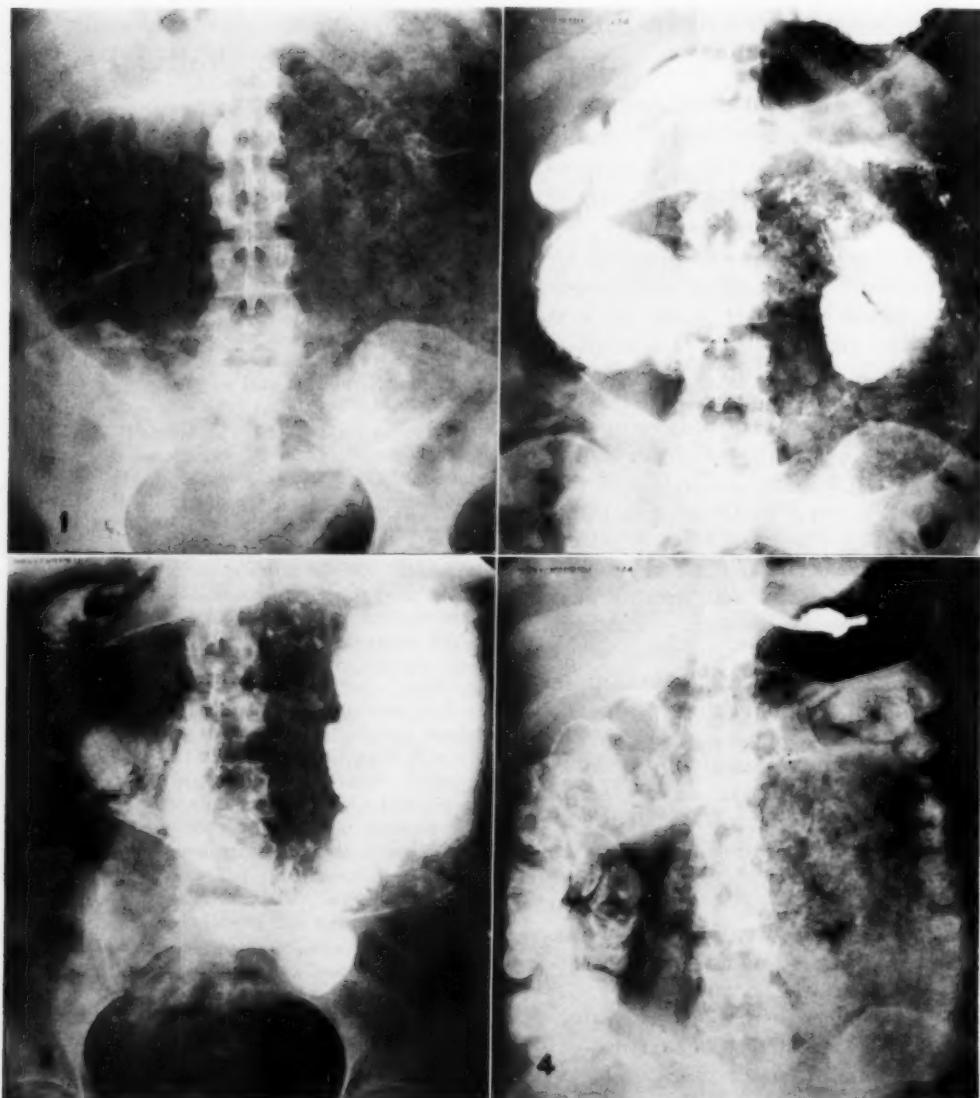


Fig. 1. Initial plain roentgenogram of the abdomen demonstrating a large amount of gas in what appeared to be a hollow viscus.

Fig. 2. Gastrointestinal roentgenogram showing barium entering the cavity after one hour. The stomach is seen at the top of the film.

Fig. 3. Twelve-hour film showing most of the barium in the cavity and some re-entering the small bowel.

Fig. 4. Twenty-four-hour film. All of the barium is in the large bowel. None remains in the cavity.

On the day of admission a plain roentgenogram of the abdomen (Fig. 1) revealed a large amount of gas in what appeared to be a hollow viscus in the mid-abdomen. This was believed to represent a dilated stomach. A gastrointestinal study attempted a few days later was unsuccessful, but enough barium entered the stomach to delineate that organ and

separate it from the above described gas collection.

On Dec. 9, a second gastrointestinal study was performed, and barium was seen to enter the gas-containing cavity after one hour (Fig. 2). After twelve hours most of the barium was in the cavity and some was re-entering the small bowel (Fig. 3). By twenty-four hours all was in the large bowel (Fig. 4).

On Dec. 14, a laparotomy was performed. A large abscess completely filled the lower two-thirds of the abdominal cavity, limited above by the transverse colon and mesocolon and extending downward roughly to the pelvic brim. Its lateral walls were formed by the lateral gutters and the ascending and descending colon. Its anterior wall was formed by the greater omentum. The abscess cavity contained many ounces of undigested food which had apparently packed into the right lower half of the cavity and formed a false channel for the passage of the barium meal. In addition there was a stringy necrotic cast of the small bowel. At the lower limit, was the stoma of the distal ileum some 5 to 6 feet from the ileocecal valve. It was evident, therefore, that the abscess cavity had maintained the continuity of the bowel. The root of the mesentery had a double twist in a clockwise fashion. A duodenileostomy was performed, followed by death on the fifth postoperative day. Autopsy was not obtained.

DISCUSSION

This case is unique in respect to the length of survival following occurrence of the volvulus. Early operation in cases of acute volvulus of the intestine is usually considered imperative. This patient, however, lived thirty-eight days before the second operation and appeared relatively comfortable. This fact can be explained by the sealing off of necrotic bowel by the omentum.

That the diagnosis was missed preoperatively is not surprising. Ripstein and Miller (6), reporting 23 cases of small bowel volvulus from the Royal Victoria Hospital, state that a correct diagnosis was made in only 4. Of 36 cases reported by Moretz and Morton (7), 7 were correctly diagnosed. The most frequent preoperative diagnosis was mechanical obstruction. The various preoperative diagnoses have ranged from ruptured peptic ulcer to strangulated umbilical hernia. Thus it can be seen that a diagnosis of volvulus of the small bowel is difficult because of the lack of a characteristic syndrome.

The cause of volvulus of the small bowel in the immediate postoperative period is unknown. Turner and Sloan feel that the bowel is prevented from returning to its

normal position because of the paralytic ileus that usually follows an operative procedure. In each of their 3 cases manipulation of the bowel was necessary. In 2 cases a Trendelenburg position was utilized and the small bowel was padded off; in the third case, examination of the ileum was carried out through a McBurney incision. In our case, also, a McBurney incision was employed in the first operation and the abdominal contents were examined. It appears possible, therefore, that this condition may arise as a result of inadvertent rotation of the small bowel, by the hand of the surgeon, through an arc of 180 degrees or more during palpation of the abdominal contents through a small incision.

SUMMARY

A case of postoperative volvulus of the entire small intestine is presented, with preoperative gastrointestinal studies. The authors agree with Turner and Sloan that this condition may be caused by manipulation of the small bowel during the previous operative procedure.

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(Para el sumario en español, véase la página siguiente.)

SUMARIO

Vólvulo de Todo el Intestino Delgado en el Período Postoperatorio Inmediato

Preséntase un caso de vólvulo de todo el intestino delgado en un enfermo de treinta años, a continuación de una exploración abdominal a través de una incisión de McBurney. No se hizo el diagnóstico preoperatoriamente, aunque se tomaron radiografías. Al operar, se descubrió un absceso grande que llenaba los dos tercios inferiores de la cavidad abdominal. Este se hallaba limitado por arriba por el colon transverso y el mesocolon, extendiéndose hacia abajo casi hasta el estrecho superior. La raíz

del mesenterio mostraba una doble torsión circular estilo reloj. La larga sobrevivencia—38 días—después de la aparición del vólvulo en este caso se atribuye a la obturación del intestino esfacelado por el epiplón.

Repásase la literatura, conviniendo los AA. con Turner y Sloan en el sentido de que el vólvulo de la forma descrita puede ser provocado por la manipulación del intestino delgado a través de una incisión pequeña.



Infarction of the Colon, Demonstrated by Barium Enema¹

JACK E. ENGELHARDT, M.D., and GEORGE JACOBSON, M.D.

NUMEROUS articles have been published concerning thrombosis of the superior mesenteric vessels, with only occasional mention of occlusion of the inferior mesenteric vessels. The following case is of interest since, to our knowledge, there has been no previous report of inferior mesenteric thrombosis demonstrated by barium enema.

CASE REPORT

A 64-year-old male was admitted to the Los Angeles County Hospital with a history of rheumatic heart disease of ten years duration and increasing cardiac decompensation. Seven days before admission he had experienced a reddish, watery diarrhea, which subsided in two days. This recurred three days before entrance, together with the onset of gradually increasing abdominal distention and severe persistent pain in the region of the umbilicus and lower abdomen. Following this, hematemesis occurred, and large amounts of coffee-ground material were vomited.

On physical examination, the patient appeared emaciated and both chronically and acutely ill. The temperature was 99.8°, pulse 120, blood pressure 110/70, respirations 30. The heart was markedly enlarged, with a grade IV systolic murmur, which radiated into the axilla. The abdomen was moderately distended, more especially in the left lower quadrant. There was diffuse tenderness with guarding, but no rigidity. The bowel sounds were hypoactive. The blood count and urinalysis were essentially normal.

Radiologic findings were as follows: A scout film showed loops of markedly distended small intestine in the right abdomen and pelvis and numerous loops of dilated large and small bowel in the left abdomen. Because of the possibility of mechanical obstruction, a barium enema study was undertaken. This revealed the colon in the region of the splenic flexure to be markedly narrowed and stiff, with thick, edematous mucosa, almost polypoid in appearance. The mid transverse colon and descending colon were slightly narrowed, with minimal irregularity of the wall (Fig. 1). Because of the serious condition of the patient, a post-evacuation film could not be obtained. Death occurred shortly after the examination.

At postmortem examination, performed by Doctor



Fig. 1. Barium-enema study, showing a narrowed, rigid segment of the splenic flexure, with thickened edematous mucosa. Minimal irregularity of the wall of the transverse colon and portions of the sigmoid are also demonstrated.

John Zaro, the essential findings were as follows:

Cardiovascular System: Moderately enlarged heart with mitral valve changes consistent with severe mitral insufficiency.

Digestive System: The peritoneum was clear. The entire small intestine appeared dusky, with dilatation and evidence of congestion from the jejunum to the terminal ileum. The stomach contained coffee-ground material; the mucosa was soft and friable. The left half of the transverse colon, including the splenic flexure, and about a third of the descending colon were infarcted. Multiple, organizing, recently formed clots were present in the vessels supplying this area of the colon.

DISCUSSION

The ratio of thrombosis of the superior mesenteric artery to thrombosis of the in-

¹ From the Departments of Radiology, School of Medicine, University of Southern California, and the Los Angeles County Hospital. Accepted for publication in December 1955.

ferior mesenteric artery as stated by different authors has varied. Whittaker and Pemberton (7), in a review of 50 autopsied cases, found the superior mesenteric vessels to be involved in 43 instances and the inferior mesenteric vessels in 1, with combined inferior and superior occlusion in 2 and combined arterial and venous occlusion in 4. McClenahan and Fisher (5) reported that, of more than 100 cases of mesenteric arterial occlusion, 96 per cent were in the superior mesenteric artery, with the remaining 4 per cent distributed in the inferior mesenteric artery and celiac axis. Among 44 cases reported by Laufman and Scheinberg (4), 2 involved the inferior mesenteric artery.

Frimann-Dahl (3) reported thrombosis of the superior mesenteric artery to be forty times more frequent than thrombosis of the inferior mesenteric artery, with the condition appearing more frequently in the arteries than in the veins. Reviewing a series of 1,142 cases of mesenteric vascular occlusion collected from the literature, Carter (1) found the arteries involved in 51.2 per cent, the veins in 43.8 per cent, and both in 6 per cent.

The greater frequency of occlusion of the superior mesenteric artery as compared with the inferior artery has been attributed to the larger size of the former (it is about three times the size of the inferior artery), its higher point of origin from the abdominal aorta, and the fact that it comes off almost parallel to the latter, while the inferior artery comes off at nearly a right angle and is thus less likely to intercept an embolus (6).

Obstruction of the inferior mesenteric vessels, because they are not terminal, may be less serious than that of the superior mesenteric vessels. In addition, the establishment of collateral circulation, with

the middle and inferior hemorrhoidal arteries below and the superior mesenteric artery above, may serve to prevent infarction (2).

In most instances, thrombosis of the superior mesenteric vessels results in an "acute surgical abdomen," while thrombosis of the inferior mesenteric vessels may present a less acute and more confusing picture. The latter has rarely been diagnosed clinically. When the condition is suspected, a barium enema may be helpful. In the case reported here, a large, sharply demarcated segment of the splenic flexure of the colon was seen to be rigid and narrowed. The mucosa in this area was edematous, with a polypoid appearance. These changes, however, are not characteristic and can lead to confusion with either an ulcerative inflammatory process or an extensive infiltrating neoplasm.

CONCLUSION

A case is presented of thrombosis of the inferior mesenteric vessels, resulting in infarction of the colon. This was demonstrated by barium enema.

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SUMARIO

Infarto del Colon, Revelado por Enema de Bario

Comunicase un caso de trombosis de los vasos mesentéricos inferiores, dando por resultado infarto del colon. Fué descubierto con un enema de bario, confirmándose en la autopsia. El estudio con bario reveló que el colon en la región de la flexura esplénica estaba notablemente estrechado y tieso, con la mucosa edematosa y espesada, tomando aspecto casi polipoideo. El colon

meso-transverso y el descendente estaban levemente estenosados, con irregularidad mínima de la pared.

Cítanse de la literatura estadísticas que reflejan la mayor incidencia de trombosis de la arteria mesentérica superior comparada con la oclusión de la mesentérica inferior, así como las posibles razones de esto.



Leiomyoma of the Jejunum with Hemorrhage¹

ROBERT L. BRADLEY, M.D., EUGENE H. SHORT, M.D., and MICHAEL M. KLEIN, M.D.

SMOOTH-MUSCLE tumors of the gastrointestinal tract are uncommon. They grow slowly and produce rather definite signs and symptoms and are nearly always resectable. In the absence of metastases, distinction between benign and malignant forms cannot be made



Fig. 1. Roentgenogram showing tumor in the first portion of the jejunum.

grossly. Histologically the presence of two or more mitotic figures per high-power field and poor differentiation indicate malignancy. The malignant tumors usually grow slowly and metastasize late. Surgical excision is the treatment of choice and affords a high percentage of cures.

These tumors may be subserosal, intramural, or submucosal. They are rarely of the hourglass type. The submucosal lesions may ulcerate and bleed or may lead to intussusception. When occurring in the duodenum, they mimic duodenal ulcer, with pain, spasm, and bleeding. Intra-



Fig. 2. Section of jejunum showing submucosal tumor with ulcer.

mural lesions are most commonly incidental autopsy findings, in the form of pea-shaped nodules in the stomach wall. Subserosal tumors produce symptoms only when relatively large; such symptoms are the result of torsion or pressure by the mass. Because of the favorable prognosis, awareness of this type of lesion and its behavior is important. The following case is typical of benign leiomyoma of the small bowel with hemorrhage.

CASE REPORT

M. C. S., a 74-year-old white male, was admitted to the hospital Dec. 14, 1954, for arteriosclerotic disease with decompensation. He gave a history of pain in the chest, most severe on exertion, beginning about a year earlier, and of some ankle edema at night for the past two years. He had been taking digitalis for four years.

The blood pressure was 120/68 and the pulse 99 and regular. Râles were present in both lung bases and a systolic murmur was audible at the apex of

¹ From Veterans Administration Hospital, Huntington, W. Va. Accepted for publication in December 1955.

the heart, being transmitted to the left axilla. The liver was slightly enlarged. The ankles and feet showed 3-plus edema.

On the day of admission the white blood cell count was 10,200, hemoglobin, 7.5 gm. per cent, and red cell count 4,190,000. Repeated hemoglobin estimates ranged between 5.5 gm. and 9 gm. per cent. Roentgen examination of the chest showed a hypertensive type of heart, a rather wide aortic shadow, and mild congestive changes in both lung fields. Gastrointestinal studies revealed a diverticulum of the duodenum and a sessile tumor of the jejunum just distal to the ligament of Treitz.

After preliminary surgery for unrelated conditions, a tumor of the proximal jejunum, with a 6 cm. segment of bowel and its mesentery, was resected on April 20, 1955, and an end-to-end anastomosis of the jejunum was carried out. The tumor was sub-

mucosal, with an active bleeding ulcer measuring 1 x 1.5 cm. Convalescence was uneventful. The patient's blood count returned to normal and he has remained in excellent health. The microscopic diagnosis was benign leiomyoma of the jejunum.

SUMMARY

A case of smooth-muscle tumor of the jejunum with hemorrhage is reported. The presenting symptoms were typical of many leiomyomas and leiomyosarcomas of the gastrointestinal tract.

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SUMARIO

Leyomioma del Yeyuno con Hemorragia

Los tumores del músculo liso del tubo gastrointestinal son raros, pero, debido a su pronóstico favorable, es importante que el roentgenólogo se dé cuenta de su posible existencia y de su comportamiento. Comunicase un típico caso de leyomioma

benigno del yeyuno, con ulceración y hemorragia. El enfermo, sujeto de 74 años, de raza blanca, mostró una reposición excelente después de la resección del tumor con un segmento de 6 cm. de intestino, y anastomosis término-terminal.



Mandibular Block by Osteochondroma

of the Coronoid Processes¹

CMDR. FRANCIS H. HOLMES, MC, USN

TWO CASES OF osteochondroma of the coronoid processes of the mandible are presented because of the rarity of reports of this condition, because the diagnosis is so easily missed on routine roentgenography, and because, with awareness of the condition and proper films, a disabling condition may be cured by simple surgical means.

CASE I (Figs. 1-4): C. H. P., a 30-year-old white male in no distress, well nourished and well developed, complained only of inability to open his mouth normally. He had first experienced difficulty at the age of fourteen and it had grown progressively worse. No pain was ever present in the temporal region. There was no history of trauma. Examination at two or more hospitals had led to a diagnosis of arthritis involving the temporomandibular joints.

The only significant finding on physical examination was inability to open the mouth more than 7 mm. A forcible attempt at wider opening was unsuccessful. Laboratory studies were negative. Roentgenograms were interpreted as showing hyperplasia of the coronoid processes with exostoses of the zygoma at the point of contact.

On Dec. 21, 1953, under Xylocaine anesthesia, an intraoral exploration was performed and the coronoids were palpated with difficulty. There was a mild infection following this, and definitive therapy was postponed until Jan. 22, 1954, when a right coronoideectomy was performed. Immediately the space between the teeth could be increased to 1.2 cm., although there was now lateral deviation. On Feb. 4, a left coronoideectomy was performed and immediately the patient could separate the teeth by 1.7 cm. He was sent on leave, with exercises prescribed, and on his return to be discharged he could open his jaws to 2.8 cm.

On Jan. 4, 1955, the patient was seen by the surgeon, Capt. William Van Zile, and had full ability to open his mouth. There were no other complaints.

Operative specimens were reported by the pathologist, Dr. M. S. Bowman, as consisting of compact bone from the coronoids and exostoses of the zygoma. Thoma (1) believes that these start as osteochondromata since they develop at a surface where there is a tendinous attachment, usually

beginning at approximately fourteen years of age. No chondromatous element was apparent in the removed specimen in this case. Despite this lack, the diagnosis of osteochondroma was considered correct according to the clinical history.

CASE II (Figs. 5 and 6): A. R., a 36-year-old man in no acute distress, complained only of inability to open his mouth. At the age of thirteen he had fallen and sustained a cut on the chin, but the present complaint did not develop until a year later. It had grown progressively worse. Examination on two previous occasions had not resulted in a clear-cut diagnosis.

Physical examination was negative except that the patient could not open his mouth more than 8 mm. on the left and approximately 1.4 cm on the right. When the mouth was opened, there was definite deviation of the mandible.

On Sept. 9, 1955, a left coronoideectomy was performed, following which the mouth could be opened 1.4 cm bilaterally. In October 1955 the patient could open his mouth to 1.8 cm.

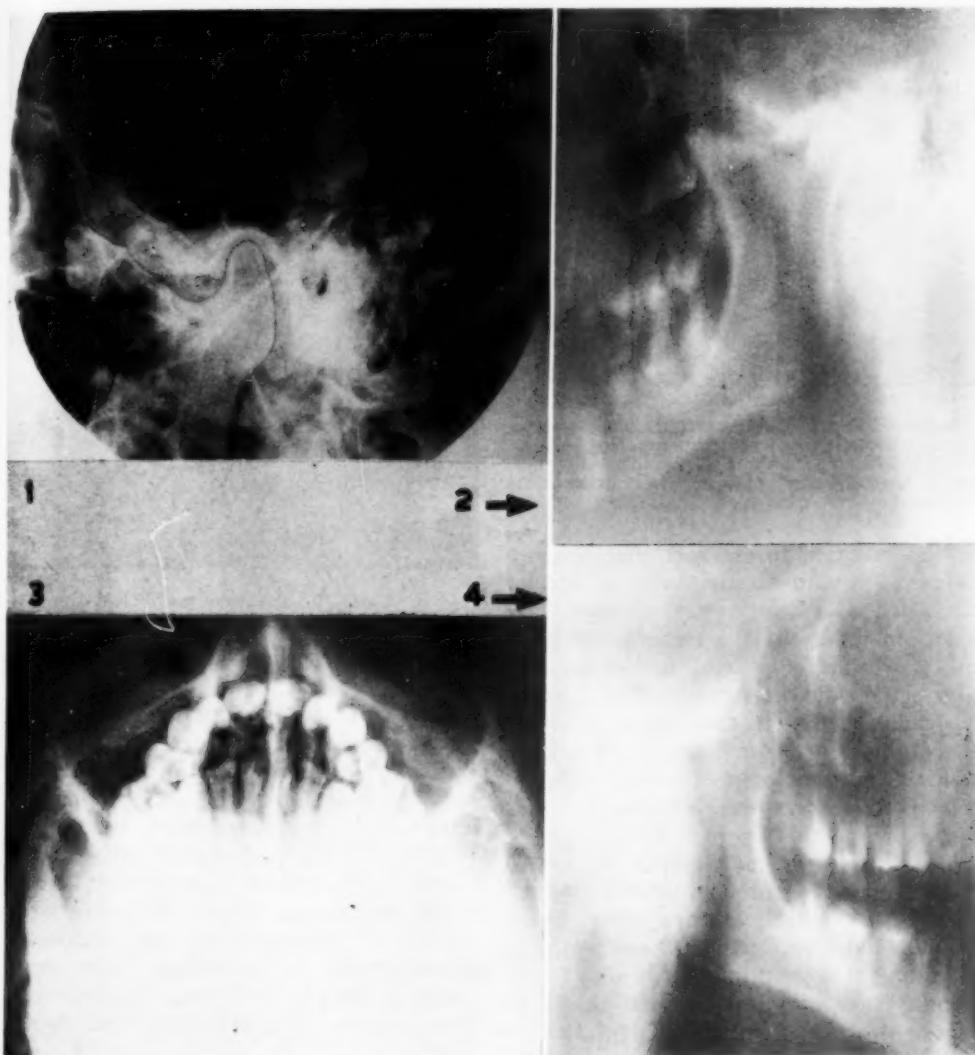
The pathological report, as given by Dr. Allen Rafferty, was as follows: The gross specimen measures 5.5 x 1.3 x 1.0 cm. Microscopic section shows continuity of thickened trabecular bone with dense cortical bone through the tumor and tip of the coronoid. Over the dome of the tumor there are nests of cartilaginous cells that appear regressive and partially calcified. There are marked condensation and thickening of the overlying periosteum. All elements are well differentiated and there is no evidence of growth activity.

Diagnosis: Osteochondroma of coronoid process, left mandible.

DISCUSSION

In July of 1943 Shackelford and Brown (2) first reported blocking of mandibular movement by an osteochondroma. In the same year a similar case was described by Brandt (4), which he considered as congenital in origin. Shackelford and Brown (3) later published 4 cases, including 2 mentioned in their earlier report and 1 described as an "osseous overgrowth of the zygoma." Brailsford reported an example in 1952.

¹ From the U. S. Naval Hospital, Great Lakes, Ill. The opinions expressed are those of the author and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.
Accepted for publication in October 1955.



Figs. 1-4. Case I.

Fig. 1. Temporomandibular joint, showing difficulty of demonstrating the coronoid process on this view. Retouched to bring out coronoid.

Fig. 2. Laminagram of right coronoid demonstrating elongation and exostoses of zygoma.

Fig. 3. Submentovertebral projection with head tilted to left, showing right coronoid best but with some visualization of left.

Fig. 4. Laminagram of left coronoid.

Shackelford and Brown, in commenting on their cases, called attention to the paucity of reports of the condition in the world literature, in view of which their experience seemed somewhat unusual. It may be merely coincidence that the 2 cases reported here were observed within a

relatively short time. The actual incidence remains a matter of conjecture, which is understandable when it is recalled that, though both the cases reported above had been previously examined, the diagnosis had not been made.

Shackelford ascribed the rarity of reports

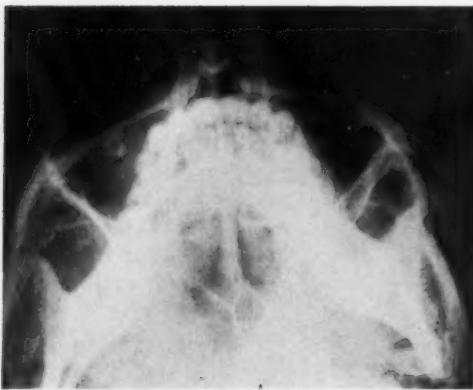


Fig. 5. Case II. Submentovertex view showing normal coronoid on right and hypertrophied coronoid on left. For this view the head should be tilted further to the right to afford better visualization of the left coronoid.

of the condition to the fact that few are aware of it and to the need of special views for diagnosis. Only a single case has been reported in a radiological journal, the others appearing in the surgical and orthopedic literature. The present report is the first in the American radiological literature. It seems logical that dentists and radiologists should be the key persons to be informed as to the possibilities.

The three cardinal points in osteochondroma of the coronoid process, according to Shackelford, are progressive mandibular blocking, painless and usually beginning at around fourteen years of age; inequality of movement of the mandible on the two sides; enlargement of the tip of the coronoid found by intra-oral digital examination.

In our Case I only the first and last of these points were present. Inequality of movement was not originally present since the condition was bilateral. Incidentally this case appears to be the only one of bilateral osteochondromata reported.

It is worthy of note that both patients had been previously examined without the true diagnosis being made. The first case had been examined radiologically on at least two earlier occasions, with a diagnosis



Fig. 6. Case II. Laminagram of left coronoid.

of arthritis despite the fact that the temporo-mandibular joints appeared normal. A more complete examination, with special views, would have suggested the true cause, and definitive treatment could have been carried out much earlier. Shackelford recommends a submento-vertex projection with the head slightly tilted to the unaffected side. As demonstrated in Figures 3 and 5, this gives a definitive view, which is sufficient for the diagnosis. Laminagraphy has provided a more exact study of the coronoids without distortion. The cuts are taken at a 2 to 3 cm. depth. The view suggested by Shackelford, however, is less time-consuming and is adequate for the diagnosis.

SUMMARY

1. A review of the literature on osteochondroma of the coronoid is presented.
2. Two cases are presented, one of which was bilateral.
3. The need of special views for diagnosis is emphasized.

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SUMARIO

Bloqueo Mandibular por Osteocondroma de las Apófisis Coronoides

Anótanse 2 casos de osteocondroma de la apófisis coronoides del maxilar inferior, uno de ellos bilateral. La dolencia no ha sido mencionada más que rara vez, probablemente debido a falta de reconocimiento de su posibilidad y además debido a necesitarse vistas *ad hoc* para descubrirla radio-

lógicamente. Suele ser indolora, consistiendo el único síntoma en incapacidad para abrir la boca normalmente.

Una vista submento-vértice con la cabeza inclinada hacia el lado indemne aporta el diagnóstico. La rectificación quirúrgica es sencilla y eficaz.



Traumatic Torsion of the Lung

Case Report¹

RAYMOND E. PARKS, M.D.

IN 1954, Stratemeier and Barry (1) reported what appears to be the first case of torsion of the lung following trauma recorded in medical literature. Their patient, a six-year-old boy who was struck by a vehicle, had a tire mark on the lower left chest. X-ray examination showed a curved, striated pattern extending from the left hilus upward to the left apex, with a partial pneumothorax bilaterally. Death occurred six hours after admission. At autopsy, the left lung was found to be rotated anteriorly, with its base assuming a superior position and its apex in an inferior position. The inversion was 180° about a transverse (coronal) axis through the left hilus. The curved, striated pattern represented the inverted vascular trunks supplying the lower lobe, then in the apex of the left thoracic cavity. The torsion was believed to have been brought about by the sudden compression of the left lower chest by the weight of the vehicle, causing displacement of the lower lobe cephalad. The sudden release of the pressure allowed the expanded upper lobe to move more caudad and occupy the space normally filled by the lower lobe.

Recently, we observed a case of torsion of the lung which was strikingly similar to that of Stratemeier and Barry.

On March 24, 1955, a seven-year-old white girl fell from a moving vehicle and a front wheel passed over the lower chest anteriorly. Examination, on admission to the emergency room of the Jackson Memorial Hospital, revealed a 2-inch laceration of the extensor surface of the left arm, fractures of the fourth to ninth left ribs, and a fracture of the left femur. The initial roentgenogram of the chest is shown in Figure 1. The physical findings suggested intra-abdominal bleeding, and an exploratory laparotomy was done twelve hours after admission. An extracapsular rupture of the spleen and retroperitoneal hemorrhage were found, and splenec-

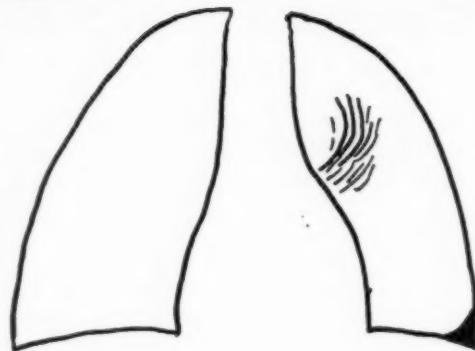


Fig. 1.A. Initial roentgenogram, taken at admission, with sketch emphasizing the characteristic curved linear densities extending from the left hilus upward to the apex, due to inverted vascular trunks.

tomy was performed. Roentgenograms made on the second and third hospital days disclosed homogeneous clouding of the left chest, which was assumed to represent a massive hemothorax. Attempts at thoracentesis, however, were unsuccessful.

Because of the patient's critical condition, management was by supportive therapy during the next six weeks. There was slow improvement during this period, but a low-grade fever persisted. Films continued to show a homogeneous density of the left chest. On May 4, a left thoracotomy was performed for decortication of the presumed organized left hemothorax. The surgeon, however, was unable to find a cleavage plane and broke through

¹ From the Radiology Department, Jackson Memorial Hospital, Miami, Fla. Accepted for publication in December 1955.

the visceral pleura. The lung tissue was necrotic and friable, and a pneumonectomy was therefore undertaken. At exposure of the hilus, the lung was seen to have rotated 180° in a clockwise direction, viewed from the lateral to the medial aspect. All structures of the lung root were included in the torsion. The superior segment of the lower lobe appeared atelectatic but was not necrotic and was successfully aerated by endotracheal pressure. The other portions of the left lung all showed evidence of gangrene. Why the superior segment, which now occupied a position corresponding to the usual location of the lingular segments, was spared is not clear, but there was apparently less compression of its blood supply by the torsion of the vascular trunks. All of the lung was resected, with the exception of the superior segment of the left lower lobe.

Pathologic study of the surgical specimen revealed necrotic lung, areas of organizing hematoma and a single oval egg with structural characteristics suggesting *Schistosoma* (the patient lived in Puerto Rico). The child made a complete recovery and was discharged from the hospital with a cast on the fractured left leg. Subsequent visits to the Out-Patient Clinic showed full recovery from all injuries six months after the accident.

The similarity of this case to the one previously reported is apparent, with respect to the age of the patient, the type of trauma, and the lung involved. The appearance on the initial chest film was the same, with a curved, striated pattern extending from the left hilus upward to the apex. The radiographic finding of curved,

striated, linear densities is not pathognomonic, as these may be seen in association with other pulmonary lesions, such as infections, but their presence following severe trauma to the chest should definitely suggest torsion. Stratemeyer and Barry found a partial pneumothorax in their patient, but at no time was this observed in the case here reported. Both patients had coexisting splenic and retroperitoneal hemorrhage as other manifestations of the severe trauma to the lower chest.

It is probable that torsion of the lung occurs more frequently in children, in whom the thoracic cage is more compressible than in older persons and the lung less likely to be fixed by pleural adhesions. The fact that this condition has not previously been recorded in the medical literature by clinicians or pathologists would indicate its rarity. With the numerous serious automobile accidents occurring in recent decades, pulmonary torsion should be found with increased frequency.

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SUMARIO

Torsión Traumática del Pulmón. Historia Clínica

Presentase un caso de torsión traumática del pulmón, consecutiva a un accidente automovilístico, en una niñita de siete años. Su semejanza es notable a un caso descrito antes en *RADIOLOGY*, con respecto a edad, forma del traumatismo y pulmón afectado. Estos 2 casos parecen constituir el total de los comunicados en la literatura.

Una radiografía torácica tomada al ingreso reveló un patrón estriado, curvo, que se extendía desde el hilus izquierdo hacia arriba hasta el vértice, representando

troncos vasculares invertidos. A continuación de la laparotomía exploratoria y la esplenectomía, nuevas radiografías revelaron enturbiamiento homogéneo en la porción izquierda del tórax que se dió por sentado representaba un hemotórax masivo. En la toracotomía, se descubrió que el tejido pulmonar estaba esfacelado y friable, y se emprendió una neumonectomía, observándose entonces rotación circular de 180° estilo reloj del pulmón, al contemplarlo de la cara lateral a la media. La reposición postoperatoria fué completa.

Roentgenographic Examination of Infants in an Incubator

A New Device Insuring Environmental Constancy¹

ROBERT M. LOWMAN, M.D., LEONARD DAVIS, M.D., HENRY K. SILVER, M.D., and WILLIAM NYHAN, M.D.

DEVELOPMENT of an improved roentgenographic technic utilizing a simple, inexpensive modification of the standard incubator has overcome the serious objections to adequate roentgenographic study of ill or delicate infants. The danger of compromising the constancy of the environmental temperature, humidity, or oxygen supply has been eliminated. Speed and manipulation are no longer important factors in satisfactory examination.

Essentially, the standard incubator is used with no alteration of its mechanics. Instead of the metal deck and rubber mattress, however, a plastic radiolucent platform, measuring 66 × 35.5 cm., is introduced for the infant to lie upon. The radiolucent plastic platform is raised by ledges approximately 5.5 cm. from the floor of the incubator, to permit easy introduction of a cassette. (Fig. 1).

For the examination, a standard 10 × 12-inch cassette is covered by a sterile sheet or pillow slip and introduced beneath the platform, the incubator hood being lifted only briefly for this purpose. With slight modification for special cases, the films are taken at 300 ma, 55 kv, 1/60 second, with a target-to-film distance of 36 inches. The anteroposterior film usually can be made without restraint of the patient.

At the Grace-New Haven Community Hospital ill infants are routinely placed in an incubator containing the radiolucent plastic platform and, as radiographic examinations are desired, are wheeled to the radiology department without delay or unnecessary manipulations. Both before and immediately after the films are taken, the incubator can be linked to a source of electricity to avoid alteration in oxygen supply, temperature, or humidity. As a

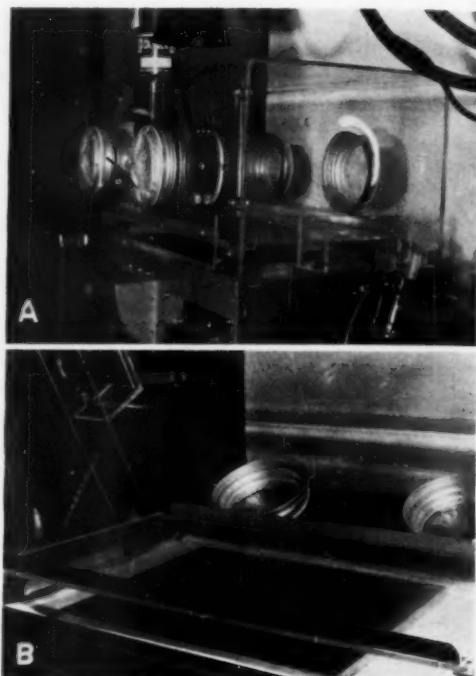


Fig. 1. A. Standard incubator with the platform in place. The x-ray cassette is slipped under the platform by utilizing the incubator hood.

B. Close up of A. The hood has been tilted backward. The plastic radiolucent platform is shown in position with the x-ray cassette.

further precaution it has been found useful to introduce a small portable oxygen tank in the cabinet portion of the incubator, attached to the oxygen inlet, so that the supply of oxygen can be uninterrupted. Oxygen administration, we have found, need not be discontinued during the examination, though we have routinely disconnected the incubator for the short period during which the films are being made.

As is demonstrated in the accompanying

¹ From the Departments of Pediatrics and Radiology, Yale University School of Medicine, New Haven, Conn. Aided by a grant from the Medical Research Fund of the Yale University School of Medicine. Accepted for publication in December 1955.

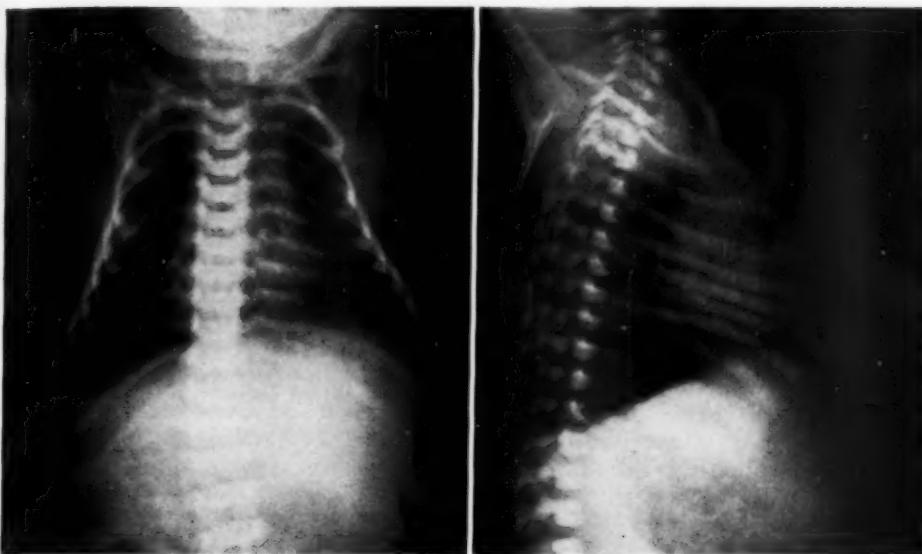


Fig. 2. Routine anteroposterior and lateral views made in the incubator. These views should be compared with studies of the same infant in Fig. 3. Distortion is minimal.

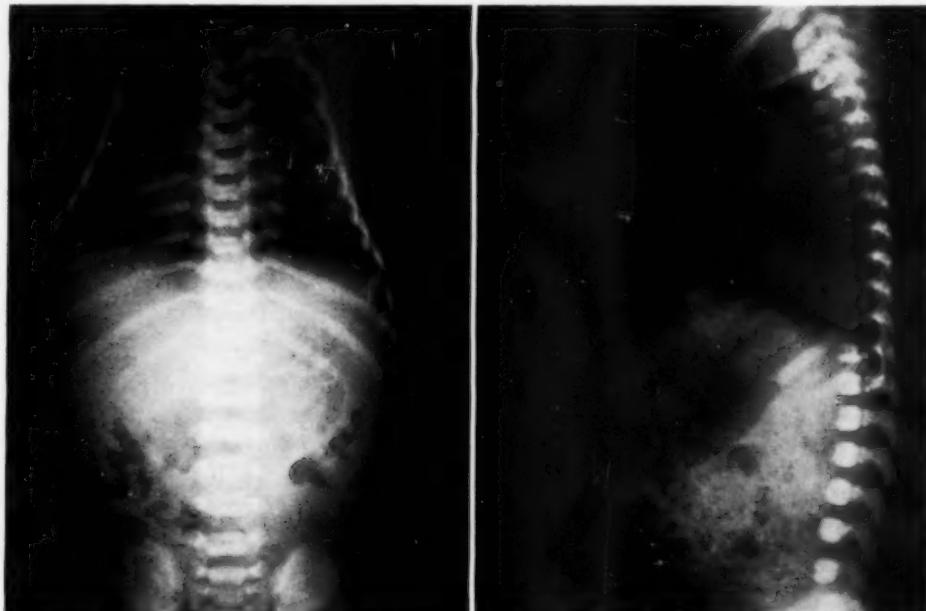


Fig. 3. Films made outside of the incubator for comparison with those of the same child in Fig. 2.

radiographs, the incubator causes no distortion which would interfere with the interpretation of the film, and affords a convenient method for repeating an exami-

nation under identical conditions, without compromising the state of the infant. In Figures 2 and 3, films of the same normal, healthy infant, taken in the incubator and

outside, are reproduced to illustrate the absence of significant change in radiographic appearance.

The value of this method has been demonstrated in our unit over the course of the past year, with elimination of the delays and inadequacies usually associated with portable film taking. Studies have been carried out shortly after birth on premature infants weighing as little as 600 gm. and complete x-ray studies on seriously ill babies have been possible.

The availability of this apparatus has minimized the objection of clinicians to complete roentgen studies and serial examinations of their infant patients. In particular, utilization of this apparatus

has provided a basis for a coordinated attempt at adequate study of the respiratory distress syndrome and pathology in the newborn.

ACKNOWLEDGMENT: We wish to thank Samuel Gibbons of Air-Shields, Inc., who made the plastic platform.

Grace-New Haven Community Hospital
789 Howard Ave.
New Haven 4, Conn.

REFERENCES

SILVER, H. K., NYHAN, W. L., AND LOWMAN, R. M.: An Improved Technique for X-Ray Examination of Newborn Premature and Full-Term Infants. *Am. J. Dis. Child.* **88**: 801, December 1954.

SILVER, H. K., AND NYHAN, W. L.: A Technique for Roentgenographic Examination of Newborn, Premature, or Ill Infants Without Removal from an Incubator. *Pediatrics* **14**: 666-667, December 1954.

SUMARIO

Examen Roentgenográfico de los Lactantes en una Incubadora. Nuevo Accesorio que Asegura la Constancia del Ambiente

Los AA. han ideado una plataforma radiolucente plástica que introducen en la incubadora corriente para el examen radiográfico de los recién nacidos. Hay medios así para administrar oxígeno al niño durante el examen. Con este aparato,

que asegura la constancia del ambiente, ha sido posible llevar a cabo estudios poco después del nacimiento en las criaturas prematuras y hacer exámenes roentgenológicos en serie en las que están enfermas de gravedad.



EDITORIAL

Supervoltage Radiotherapy

The program of nearly every annual meeting of the several radiological societies of the United States has in recent years included papers and often symposia devoted to supervoltage radiotherapy. The increasing availability and relatively low cost of cobalt 60 has led to an enormous increase in the use of this particular form of supervoltage (roughly equivalent to a 3-million-volt x-ray generator). With few exceptions, those who have presented material have merely given early impressions, since not enough time had yet elapsed for conclusions to be drawn in terms of survival rates.

In this issue of *RADIOLOGY* there is included a Symposium on supervoltage therapy. The essayists were chosen from those few in this country who have had many years experience with this form of treatment. Their statements and the conclusions which they reach should be carefully studied.

The writer, who served as moderator of the Symposium, has had but short experience with a 2-million-volt x-ray machine and a cobalt teletherapy source, but in three years time has seen enough material to learn that there are some definite advantages in the use of supervoltage and some very serious disadvantages. In fact, advantages with regard to the patient may in some instances constitute a hazard as regards proper treatment of a malignant lesion.

It is a matter of general agreement that there is no biological advantage in radiation in the 1 to 3-million-volt range as compared with 200-250 kv therapy. Tumors which are resistant to 250-kv radiations will not be sensitive to radiations of greater energy, at least at the levels now available for therapy. On the other hand, there are

some physical advantages, such as increased depth dose, decreased side-scattering, and lessened bone absorption. In lesions surrounded by bone the decreased absorption makes dose calculation more accurate. The increased penetration allows for greater ease in treating deep-seated lesions, and the decreased side-scattering aids in sparing normal tissues. With respect to the patient, supervoltage radiation seems to produce less systemic reaction, probably due to decreased integral dose. There is less radiation sickness, and in general less hematopoietic effect. Because the point of maximum dose lies some millimeters below the surface of the skin, one of the advantages of supervoltage is that the usual skin effects are markedly decreased. This lack of reaction is not without its drawbacks, however, since often with 250 kv the skin reaction is a limiting factor, preventing overdosage of underlying structures. In addition, late fibrosis of subcutaneous tissues can occur where the limiting superficial reaction is lost and overdosage of this tissue is unwittingly given.

In general, supervoltage therapy is easier to plan than is therapy in the ordinary range. Often fewer portals can be used and dosimetry is thereby simplified. But considering the cost of equipment, installation, and maintenance, it is questionable whether these factors, as opposed to the decreased patient reactions, will justify such devices except in larger centers where selection of special cases for specific and clear indications is possible. These units cannot be operated to the entire extent of their usefulness without the full-time services of a well trained hospital physicist. The assistance of such a physicist is necessary if complicated therapy problems are

to be best handled at 250 kv, but it is imperative at supervoltage levels.

Recent years have shown a great increase in the prestige of radiotherapy for the treatment of cancer. This is due in part to greater realization of its limitations by radiologists and to the influence of the British school of scientific approach. These gains are in grave danger of being lost. Overconfidence on the part of radiologists and physicians in general is leading to the acceptance for treatment by supervoltage of cases which should not be treated by any means. False hope is being built in the minds of the general public, and unreasonable assurance given to the cancer patient and his relatives. Unwise statements have been made in the public press. Too often supervoltage equipment is installed where it will be operated by persons inexperienced in its use. Too frequently it is installed not as a benefit for patients, but as an item lending prestige to a private office, a clinic, or a hospital. This is not good for the specialty of radiology. What is of much more importance, it is not good in the

improvement of cancer therapy. Each individual cancer patient deserves the best treatment available. Good 250-kv therapy is better than inexperienced supervoltage irradiation. Experienced supervoltage therapy is better than good 250-kv treatment only in certain carefully selected cases.

Supervoltage therapy is a useful segment of the armamentarium of the radiotherapist. It is dangerous, as is any form of radiation, in the hands of the uninitiated. It cannot be expected to perform miracles but, where wisely used, can be expected to improve, albeit slightly, the ability to cure certain selected cancers and to aid materially in the alleviation of human suffering. It will by no means supplant 250-kv therapy or radium, but should evolve as another tool of limited usefulness in the hands of the careful practitioner of radiotherapy.

As long as radiologists are foremost in the treatment of cancer, 250-kv radiotherapy will continue to be our chief weapon.

J. W. J. CARPENTER, M.D.
Chicago, Ill.

RADIOLOGICAL SOCIETY OF NORTH AMERICA

FORTY-SECOND ANNUAL MEETING: PRELIMINARY PROGRAM

Palmer House, Chicago, Illinois, Dec. 3-7, 1956

Monday, December 3

OPENING SESSION: 10:30 A.M.-12:20 P.M.
SECTION A

James E. Lofstrom, M.D., First Vice-President
Presiding

Call to Order

Greetings. KARL MEYER, M.D., President, Chicago Medical Society.

President's Address. CLARENCE E. HUFFORD, M.D. Historical Lecture. Just a Wee Sketch of a Great Man, Rollin H. Stevens, M.D., 1868-1946. CLYDE K. HASLEY, M.D.

Memorial Fund Lecture. Proton Irradiation of the Pituitary and Its Metabolic Effects. ROLLIN K. McCOMBS, M.D. Introduced by FREDERICK W. O'BRIEN, M.D.

A College Report on the Present Status of Medical Care Insurance and Allied Problems. WILBUR BAILEY, M.D.

SECTION AB: 2:00-4:25 P.M.

C. Edgar Virden, M.D., President-Elect, Presiding

Radio-Isotopes Panel. HYMER L. FRIEDELL, M.D., Moderator; RULON RAWSON, M.D., KENNETH E. CORRIGAN, Ph.D., JOHN P. STORAASLI, M.D., ROBERT ROBBINS, M.D., VINCENT P. COLLINS, M.D., DWIGHT CLARK, M.D.

Therapy of Pituitary Adenomata. *DONN G. MOSSER, M.D., and K. W. STENSTROM, M.D.

The Amount of Radiation to the Lens from the Treatment of Tumors of the Eye and Adjacent Structures. *GEORGE R. MERRIAM, M.D., and ELIZABETH F. FOCHT, B.A.

The Use of Electron Beams in Industrial Processes E. DALE TROUT, B.S., D.Sc.

BUSINESS MEETING: 4:30 P.M.

COUNSELORS' DINNER: 7:00 P.M.

Tuesday, December 4

SECTION A: 10:30 A.M.-12:00 M.

Peter E. Russo, M.D., Second Vice-President, Presiding

NEURORADIOGRAPHY SYMPOSIUM
Eugene P. Pendergrass, M.D., Moderator

The Relative Importance of Myelography and Discography in the Diagnosis of Discogenic Disease. HAROLD O. PETERSON, M.D.

* Will present paper.

Small Pneumoencephalograms as a Screening Procedure in Convulsive Disorders. *LEWIS E. ETTER, M.D., and EUGENE L. YOUNGUE, M.D.

Intracranial Cytomegalic Inclusion Disease. *C. RICHARD PERRYMAN, M.D., and PAUL R. NOBLE, M.D.

Meningiomas of the Tuberculum Sella. PHILIP J. HODES, M.D.

Roentgenology of Meningiomas of the Posterior Fossa. THEODORE A. TRISTAN, M.D.

An Evaluation of the Twenty-four Hour Post-Pneumoencephalogram Examination, in Particular Reference to Cerebral Atrophy. *MAX T. SCHNITKER, M.D., and ROBERT P. ULRICH, M.D.

SECTION B: 10:30 A.M.-12:00 M.

RADIOLOGICAL UNITS AND DOSIMETRY

Lauriston S. Taylor, A.B., Presiding

Report on the 1956 Recommendations of the International Commission on Radiological Units. LAURISTON S. TAYLOR, A.B.

Review of Papers Presented at 1956 Seminar of International Commission on Radiological Units. HAROLD O. WYCKOFF, Ph.D.

The Values of W for Gases of Dosimetric Interest. L. D. MARINELLI, M.A.

Conversion of Roentgens into Rads. *S. GENNA, M.S., M. DANZKER, M.S., and J. H. LAUGHLIN, Ph.D.

SECTION AB: 2:00-4:30 P.M.

H. Milton Berg, M.D., Presiding

The Significance of the Calcified Appendiceal Enterolith. *DAVID S. CARROLL, M.D., and BOYER M. BRADY, M.D.

Gravitational Placentography. KENNETH E. HODGE, M.B., F.R.C.P. (C)

The Obstructed Uretero-Pelvic Junction. ROBERT LICH, JR., M.D.

Intravenous Cholangiographic Diagnosis of Partial Biliary Duct Obstruction. *ROBERT E. WISE, M.D., and DAVID O. JOHNSTON, M.D.

SYMPOSIUM AND PANEL: TREATMENT OF BRONCHIAL CANCER.

L. Henry Garland, M.D., Moderator

The Natural History of Bronchial Cancer. DAVID A. KARNOFSKY, M.D.

Results of Radiotherapy of Bronchial Cancer. MILFORD D. SCHULZ, M.D.

The Place of Radiotherapy in Bronchial Cancer.
FRANZ J. BUSCHKE, M.D.
The Present Status of Chemotherapy of Bronchial
Cancer. BERNARD ROSWIT, M.D.
Discussion. Opened by W. VAN HAZEL, M.D.

BUSINESS MEETING: 4:30 P.M.**THE CARMAN LECTURE: 8:30 P.M.**
Lowell S. Goin, M.D.

Presentation of the Gold Medal of the Society
Announcement of the Scientific Awards

Wednesday, December 5**SECTION A: 10:30 A.M.-12:00 M.**
Sidney J. Hawley, M.D., Presiding

Panel on Pediatric Radiology. JOHN W. HOPE, M.D.,
Moderator; ROBERT P. ALLEN, M.D., JOHN F.
HOLT, M.D., C. EVERETT KOOP, M.D., HARVEY
WHITE, M.D., and MARTIN H. WITTENBORG, M.D.

SECTION B: 10:30 A.M.-12:00 M.**BIOLOGICAL EFFECTS OF RADIATION**
A. Hollaender, Ph.D., Presiding

Report on the 1956 Recommendations of the International Commission on Radiological Protection.
LAURISTON S. TAYLOR, A.B.

Estimation of the Effect of Whole Body Radiation upon Human Longevity. HARDIN B. JONES, M.D.

Genetic Considerations in Establishing Maximum Radiation Doses. JAMES F. CROW, Ph.D.

Delayed Effects of Ionizing Radiation. CHARLES E. DUNLAP, M.D.

Considerations Bearing on Permissible Accumulated Doses for Occupational Exposure. G. FAILLA, D.Sc.

Attention is directed to a closely related Refresher Course to be given by Dr. R. F. Kimball, Oak Ridge National Laboratory, on Monday, Dec. 3. This course will provide some background and a better understanding of the genetic considerations in the problem of permissible radiation levels.

SECTION AB: 2:00-5:00 P.M.
Lawrence L. Robbins, M.D., Presiding**SYMPORIUM ON COMBINED THERAPY**
Sydney F. Thomas, M.D., Moderator

Quantitative Biochemical Differences as a Basis for Multi-combination Cancer Chemotherapy. *DANIEL M. SHAPIRO, M.D., M.E. SHILS, M.D., and L.S. DIETRICH, M.D.

Augmentation of Radiotherapeutic Effects by Multi-combination Cancer Chemotherapy. *MORTON M.

KLIGERMAN, M.D., and DANIEL M. SHAPIRO, M.D.
Combined Therapy: Chemicals and Irradiation.
SYDNEY F. THOMAS, M.D.

SYMPOSIUM AND PANEL: MANAGEMENT OF THE PATIENT WITH ADVANCED CANCER
Howard B. Hunt, M.D., Moderator

General Clinical and Surgical Management in Advanced Cancer. GRANTLEY W. TAYLOR, M.D.
Radiotherapeutic Management of Patients with Advanced Cancer. MILFORD D. SCHULZ, M.D.
Endocrine, Chemotherapeutic and Other Medicinal Agents in Advanced Cancer. B. J. KENNEDY, M.D.
Complications of Advanced Uterine Cancer and Their Management. HERBERT E. SCHMITZ, M.D.

SECTION C: 2:00-5:00 P.M.**RECENT ADVANCES IN RADIOLOGIC PHYSICS**
H. O. Wyckoff, Presiding

This program is arranged only a few weeks before the meeting, and details are therefore not available.

Thursday, December 6**SECTION A: 10:30 A.M.-12:00 M.**
Theodore J. Wachowski, M.D., Presiding**SYMPOSIUM: CONTRAST MEDIA IN THE DIAGNOSIS OF RETROPERITONEAL ABNORMALITIES**
Philip J. Hodes, M.D., Moderator

Barium in the Study of Retroperitoneal Tumors.
ROBERT M. LOWMAN, M.D.

Renal Tumors: Translumbar Arteriography for Their Differentiation. ARTHUR T. EVANS, M.D.

Adrenal Tumors: Their Recognition by the Use of Contrast Media. HOWARD L. STEINBACH, M.D.

Hypertension of Renal Origin: Its Recognition by Roentgen Methods. GEORGE WOHL, M.D.

Aortic Thrombosis as a Cause of Renal Hypertension, An Arteriographic Study. *BENJAMIN FELSON, M.D., and GEORGE M. WYATT, M.D.

Nephrotomography in the Investigation of Renal Masses. JOHN A. EVANS, M.D.

Complications of Retroperitoneal Contrast Studies. HENRY P. PENDERGRASS, M.D.

The Problem of Contrast Visualization of the Pancreas.
ROBERT SHAPIRO, M.D.

SECTION B: 10:30 A.M.-12:00 M.**MULTI-MEGAVOLT RADIATIONS**
W. K. Sinclair, Ph.D., Presiding

The Betatron (Color Film). WALTER S. MOOS, Ph.D.
The Stanford Medical Linear Accelerator. *M. WEISSBLUTH, Ph.D., C. J. KARZMARK, Ph.D., A. H. SELBY, B.S., and R. E. STEELE, M.S. (Introduced by H. S. KAPLAN, M.D.)

An Experimental Determination of Absolute Energy Absorption in Water from an X-ray Beam. GAIL D. ADAMS, Ph.D.

Intercomparisons of X-ray Exposure Using Victoreen Dosimeters at Various Energies, Particularly 22 Mv. W. K. SINCLAIR, Ph.D.

SECTION AB: 2:00-4:30 P.M.

John A. Evans, M.D., Presiding

Lumbar and Peripheral Arteriography: (1) Techniques and Radiologic Anatomy. WILLIAM R. EYLER, M.D. Lumbar and Peripheral Arteriography: (2) Clinical Aspects. D. EMERICK SZILAGYI, M.D.

The Value and Hazards of Retrograde Thoracic Aortography in the Diagnosis of Congenital Cardiovascular Anomalies. HERBERT L. ABRAMS, M.D.

The Incidence of Complications of Translumbar Aortography. JOHN G. McAfee, M.D.

Panel on Present Applications of Co⁶⁰ Therapy. ISADORE LAMPE, M.D., Moderator; T. A. WATSON, M.D., JUAN A. DEL REGATO, M.D., JAMES W. J. CARPENTER, M.D., and FRANZ J. BUSCHKE, M.D.

BUSINESS MEETING: 4:30 P.M.

ANNUAL BANQUET: 8:00 P.M.

Friday, December 7

SECTION A: 10:30 A.M.-12:00 M.
Erich M. Uhlmann, M.D., Presiding

Panel Discussion of Fracture Problems. EDGAR C. BAKER, M.D., Moderator; CHARLES L. HINKEL, M.D., ARNOLD D. PIATT, M.D., DOUGLAS B. NAGLE, JR., M.D., PAUL A. JONES, M.D., WEBSTER H. BROWN, M.D., HAROLD FULTON, M.D., and FREDERICK A. BAVENDAM, M.D.

SECTION B: 10:30 A.M.-12:00 M.

RADIATION MEASUREMENT
John Hale, M.S., Presiding

Design and Calibration of Pocket Personnel Dosimeters for Beta Radiation. H. H. HUBBELL, JR., Ph.D., R. M. JOHNSON, M.A., and R. D. BIRKHOFF, Ph.D.

Determination of Continuous X-Ray Spectra by the Absorption Method. E. B. HOROWITZ, M.S., and M. DANSKER, M.S.

Determination of Disintegration Rate for Gamma-Emitting Isotopes—Gold 198. *C. L. WINGATE, M.A., W. CROSS, A.M., and G. FAILLA, Sc.D.

Radiation Hygiene Aspects of Surface Contamination. HANSON BLATZ, E.E., and W. B. HARRIS



RADIOLOGICAL SOCIETY OF NORTH AMERICA

FORTY-SECOND ANNUAL MEETING: COMMERCIAL EXHIBITS

The Commercial Exhibits Committee has felt that a preliminary guide to the exhibits to be shown at the Annual Meeting of the Radiological Society serves a better purpose than an account appearing later. It is therefore presenting the following list of exhibitors and exhibits to be seen in December. The items are of necessity brief and only suggestive of the many interesting features that will be on display.

ABBOTT LABORATORIES, INC., North Chicago, Ill. (Booth 108): The Abbott exhibit, as in past years, will be directed toward the presentation of most recent developments in the field of radioactive pharmaceuticals. Displayed for the first time will be capsules containing therapeutic amounts of radioiodine making possible a quite complete hospital program without special laboratory facilities. Among other developments to be shown will be Aurcoloid (radiogold) for the treatment of fluid accumulation associated with cancer and a new form of Actaloy providing irradiation far less expensively than radium. Handling equipment and new techniques, as well as informative literature, will be featured.

THE ANSCO CORPORATION, Binghamton, N. Y. (Booths 16 and 17).

ATOMIC ENERGY OF CANADA, LTD., Ottawa, Canada (Office 402).

THE AUTOMATIC SERIOGRAPH CORPORATION, College Park, Md. (Booth 113), will exhibit the Sanchez-Perez Universal Model 110 Automatic Seriograph, which utilizes standard 11 X 14-inch cut film and takes twelve individual cassettes, each with its own set of intensifying screens. Since the machine operates on the cassette-changing principle, the same excellent detail can be obtained as with the standard single-cassette technic. The unit has an infinitely variable interval speed and will take up to two pictures per second.

BARNES-HIND BARIUM PRODUCTS CO., Sunnyvale, Calif. (Booth 40), will display Barotраст, a specially processed micronized barium sulfate for x-ray diagnosis. Barotраст resists the effects of mucin, pH changes, and gastric secretions; it stays in suspension indefinitely and shows no clumping, precipitation, or hardening in the gastrointestinal tract.

To be shown also is the Pneumocolon, which was developed at the University of California School of Medicine for the administration of Barotраст in double-contrast technics and routine barium enemas.

BAR-RAY PRODUCTS, INC., Brooklyn, N. Y. (Booths 105 and 106): The Bar-Ray exhibit features the Hills Automatic Film Processing Machine, which automatically delivers up to 120 completely processed and dried films per hour. The Hills Tank is one of several now being built at such centers as the New England Baptist Hospital, Boston, and Roosevelt and Montefiore Hospitals in New York. It permits wet emergency viewing at any point from developer through drying. In the event of power failure, it may be converted within a few minutes to manual operation. It requires no stand-by tank and is smaller in size than other automatic tanks of the same capacity. It does not require a particular location, a costly concrete base, or special plumbing installation. Information will also be available on the Bar-Ray \$12,000 Cobalt 60 Irradiator and the Bar-Ray Archer Gown of leaded glass cloth.

BELL-CRAIG, INC., New York, N. Y. (Booth 13) is showing a variety of barium-sulfate preparations: Baropaque-A, B, and C; Raybar, flavored and unflavored; the modern flocculation-resistant, colloidal type Barloid. For hysterosalpingography and cholangiography, an improved Medopaque-H is presented. This product is aqueous, viscous, optimally radiopaque, and *completely absorbable*. For use in cholecystography, Cholex and Neo-Cholex, oral fat emulsions, are featured for reducing the time of examination and for demonstration of the bile ducts.

BLAIR X-RAY, INC., Los Angeles, Calif. (Booths 26 and 27).

BROWN-FORMAN INDUSTRIES, Louisville, Ky. (Booths 70 and 71) will introduce their new, fast-acting Automatic X-ray Film Processor and Isothermal Dryer. Their complete line of super concentrate x-ray chemicals will also be featured. Complete processing from dry-exposed to dry-processed film requires just fourteen minutes. Precise temperature control and automatic replenishment of BFI solutions assures consistently fine film quality. The unit, 10 $\frac{1}{2}$ " X 2'4", can process and dry up to 200 14 X 17-inch x-ray films per hour. The dryer, available separately, dries film in two minutes.

BUCK X-OGRAPH COMPANY, St. Louis, Mo. (Booth 65).

CARR CORPORATION, Culver City, Calif. (Booths 24 and 25): The Carr Corporation exhibit will feature a new "C" Model Stainless Steel X-Ray Developing Tank, emphasizing the wedge through wall design and the Cascade Skimmer design in the wash tanks. This unit also has the new flush-mounted timer and flush-mounted density light in its backsplash. Carr Corporation expects also to show its new automatic developing tank.

THE COCA-COLA COMPANY, Atlanta, Ga. (Booth 7): Ice-cold Coca-Cola will be served through the courtesy and cooperation of the Coca-Cola Bottling Company of Chicago, Inc., and the Coca-Cola Company.

CONTINENTAL X-RAY CORPORATION, Chicago, Ill. (Booths 114 and 115), will exhibit a new, moderately priced Spot-Film Table, featuring a fully counterbalanced spot-film tower with a choice of spot-film devices. A unique suspension system and rigid light-weight construction facilitate manipulation of all movements. Motor-driven shutters, which add much to the ease of operation, have of course been retained. The table is shown with one of the newest type automatic power units, plus a tubestand and other equipment for an ideal diagnostic installation.

CORECO RESEARCH CORPORATION, New York, N. Y. (Booth 29), will show the Coreco Automatic Color Camera designed for photographing all surface areas of the body from 1-to-1 close-up pictures to half-body size, and all body cavities, as the mouth, throat, ear, nose, vagina and rectum. The camera carries its own specially developed, fully color-corrected bulb and a mechanism for complete control of its color temperature and exposure within the camera itself. An automatic view finder is synchronized with the automatic camera mechanism to permit viewing until a fraction of a second before exposure. Provision is made for automatic focusing.

DICK X-RAY COMPANY, St. Louis, Mo. (Office 403).

DUNLEE CORPORATION, Chicago, Ill. (Booths 91 and 92), will display a complete line of stationary and rotating anode tube inserts in addition to the exclusive Dunlee Triple Tilted Anode Tube Insert with copper cathode cup. The latest in thoriated tungsten filament valve tubes with and without resistor will also be featured.

E. I. DU PONT DE NEMOURS & COMPANY, Wilmington, Del. (Booths 57-60): The Du Pont Photo Products Department will feature a display of radiographs demonstrating that there is a Du Pont "Patterson" Screen for every purpose. Also to be exhibited are a complete line of Du Pont technical aids available to radiologists for supplementing their training programs. A special demonstration of non-interleaved film will be included.

THE EASTMAN KODAK COMPANY, Rochester, N. Y. (Booths 97, 98, 109, 110).

ARMIN EASTMAN, ENCYCLOPEDIA AMERICANA, Grand Rapids, Mich. (Booth 101).

EUREKA X-RAY TUBE CORPORATION, Chicago Ill. (Booth 76), will have on display a representative selection of valve tubes, stationary anode tubes, and rotating anode tubes for medical x-ray applications. Included will be new, lightweight 100-kvp rotors, and rotating anode tubes having ratings of 100, 110, and 125 kvp. A new, interchangeable thoriated filament valve for 6- or 12-volt operation will also be shown, with fittings for adaptation to all brands of x-ray transformers.

THE FAIRCHILD CAMERA AND INSTRUMENT CORPORATION, Industrial Camera Division, Jamaica, N. Y. (Booths 82 and 83), is exhibiting the latest photofluorographic equipment, including the Fairchild-Odelca Camera in two sizes: 70 mm. and 4 × 4". These cameras feature the new mirror type optics that not only permit the use of lower tube current but also reduce exposure time by 60 to 80 per cent and improve resolution threefold. The negatives thus obtained are believed to represent true diagnostic quality. The cameras can operate at six exposures per second for angiographic and other studies.

L. M. FORSYTH MANUFACTURING COMPANY, Chicago, Ill. (Booth 100).

E. FOUGERA & CO., INC., New York, N. Y. (Booth 86), will feature Visciodol, a new Lipiodol diagnostic agent for better bronchography. Two of the greatest problems in bronchography—*alveolar penetration and delayed elimination of the contrast medium*—are avoided with Visciodol. In clinical studies, it has been shown to possess the same superior degree of contrast as Lipiodol. It is remarkably non-toxic and is less irritating than water-soluble radiopaque media. Literature and supplies of Visciodol will be available on request.

FRANKLIN X-RAY CORPORATION, Philadelphia, Penna. (Booths 88 and 89): The Franklin Corporation is exhibiting a radiographic headstand, floor-to-ceiling mounted, with all necessary accessories for examinations including those of the skull, sinuses, and mastoids. A rapid film changer will also be featured, utilizing roll film and capable of providing six exposures per second. Film frame size is 11 × 14 inches. Exposed film may be processed as roll or cut film. A mobile adjustable stand is provided for the mounting of this unit.

FRIEZ INSTRUMENT DIVISION, Bendix Aviation Corporation, Baltimore, Md. (Booths 51 and 52).

FRIGID-HEAT, Nashville, Tenn. (Booth 50).

GENERAL ELECTRIC X-RAY CORPORATION, Milwaukee, Wisc. (Booths 30-36).

GRUNE & STRATTON, INC., New York, N. Y. (Booth 69), represented by Mr. Frank Kurzer, will display such important books as *Roentgen Diagnostics* by Schinz, Baensch, Friedl, and Uehlinger; *Borderlands of the Normal in Skeletal Roentgenology* by Köhler, Zimmer, and Case; Bendick's *Diagnostic Advances in Gastrointestinal Roentgenology*; the seventh edition of Clark's *Positioning in Radiography*; Zdansky's *Roentgen Diagnosis of the Heart and Great Vessels*; and the second enlarged and revised edition of Storch's *Fundamentals of Clinical Fluoroscopy*.

HALSEY X-RAY PRODUCTS, INC., Brooklyn, N. Y. (Booths 102 and 103), will have a display well representing their extensive line of high-quality x-ray accessories. Featured will be a new lightweight, wall-mounted cassette holder with rapid action phenolic adjusting brake, a new deluxe model combination 70-mm. roll film and 4 × 5-inch cut film magnifying viewer, and a unique Full-Vue economy illuminator. The most complete line of low-cost protective floor screens will be exhibited in cut-away form. The Halsey wafer cassette will be prominently featured.

PAUL B. HOEBER, INC., Medical Book Department of Harper & Brothers, New York, N. Y. (Booth 44) extends an invitation to examine the array of new and helpful Hoeber-Harper books and journals. Of special interest are Thoms' *Pelvimetry*, Werner's *The Thyroid*, and McLaren's *Diagnostic Radiology*, 2nd Series. Also on display will be such standard and useful books as Ritvo's *Roentgen Diagnosis of Diseases of the Skull*, Dotter and Steinberg's *Angiocardiography*, Coley and Higinbotham's *Tumors of Bone*, Kaplan's *Radiation Therapy*, and Levitt's *Handbook of Radiotherapy*.

THE INTERNATIONAL MEDICAL RESEARCH CORPORATION, New York (Booth 117), will exhibit the Bucky combination therapy unit, which has a radiation range of from 5 to 140 kv depth dosage. With this single apparatus, the following modalities of radiation can be produced: grenz, contact, superficial, and intermediary. Because of its high output, this machine is well adapted for both cavity and whole-body therapy. Featured also will be a new grenz-ray therapy unit.

KELEKET X-RAY CORPORATION, Boston, Mass. (Booths 120-124), will be showing its Rotaray rotational teletherapy apparatus and its redesigned Hercules radiographic and fluoroscopic table with associated control. In addition, a representative selection of darkroom and accessory and supply items will be shown.

R. S. LANDAUER, JR. & COMPANY, Park Forest, Ill. (Booth 95), provide radiation safety services to radiologists, universities, and industrial organizations throughout the country. Their display will feature the Landauer film-badge services, with

the unique quick-change multiple-filter badge. Photographs and literature will describe the modern facilities and special systems used, as well as the convenience, promptness, high accuracy, and broad exposure coverage afforded. Mr. Landauer will be in attendance.

LEA & FEBIGER, Philadelphia, Penna. (Booth 15), invite those attending the meeting to see these recent books: Zimmerman, Netsky, and Davidoff's *Atlas of Tumors of the Nervous System*; Ritvo's *Chest X-Ray Diagnosis*; Holmes and Robbins' *Roentgen Interpretation*; Epstein's *The Spine*; Ritvo's *Bone and Joint X-Ray Diagnosis*; Davidoff and Epstein's *The Abnormal Pneumoencephalogram*; Davidoff and Dyke's *The Normal Encephalogram*; Epstein and Davidoff's *Atlas of Skull Roentgenograms*; Rhinehart's *Roentgenographic Technique*; Ritvo and Shauffer's *Gastrointestinal X-Ray Diagnosis*; Delario's *Roentgen, Radium and Radioisotope Therapy*; Wesson's *Urologic Roentgenology*; Pohle's *Clinical Radiation Therapy*; Holmes and Schulz's *Therapeutic Radiology*.

LEISHMAN X-RAY ENGINEERING COMPANY, Los Angeles, Calif. (Booth 96).

LIBERTY PROTECTIVE LEATHERS, INC., Gloversville, N. Y. (Booth 87), will display the latest types of leaded leather x-ray gloves and aprons. An especially designed flexing machine will be shown in action, as well as a leaded leather glove that has been flexed one million times without loss of opacity. X-ray films of this glove at the end of the test together with other data showing the protective qualities and durability of the Liberty products will be available.

THE LIEBEL-FLARSHEIM COMPANY, Cincinnati, Ohio (Booth 99).

LOGETRONICS, INC., Alexandria, Va. (Booth 8), will feature the new LogEtronic x-ray printer which automatically brings out detail in bone and tissue portions of the same film. Transparencies, paper prints, and lantern slides will be displayed to illustrate how LogEtronics makes x-ray detail more easily visible, saves on "retakes" caused by improper exposure or processing, and permits better illustrations in technical journals as well as more effective exhibits and lectures.

THE LOW X-RAY FILM CORPORATION, New York, N. Y. (Booths 84 and 85) extends a most cordial invitation to visit its booths. Representatives will be on hand to offer complete information on Gevaert's superlative "Curix" High-Speed X-Ray Film (for use with intensifying screens) and Gevaert's "Osray" Non-Screen Film, which is specially packed in individual, disposable, light-proof envelopes.

MACHLETT LABORATORIES, INC., Springdale, Conn. (Booths 111 and 112).

MALLINCKRODT CHEMICAL WORKS, St. Louis, Mo. (Booth 90): Members and guests of the Radiological Society of North America are cordially invited to visit the Mallinckrodt booth. Featured among their radiological diagnostic media will be Miokon, a new development for visualization of the kidney, ureter, and bladder. Also displayed will be Urokon 30, 50, and 70 per cent for cerebral angiography, translumbar arteriography, and angiocardiography. Representatives in attendance will be glad to be of service to you.

MATTERN MANUFACTURING COMPANY, Chicago, Ill. (Booths 73-75).

MICRO X-RAY RECORDER, INC., Chicago, Ill. (Booth 119), will exhibit the new and improved Micro X-Ray Recorder, a microfilming unit that will record x-rays, photographs, charts, electrocardiograms, etc., on a 100-foot roll of 35-mm. direct positive or intermediate film. To be featured also are viewers, projectors, indexers, film mounts, and other accessories.

A new series of 35-mm. 2 X 2-inch slides on various medical subjects for lectures, teaching, and reference will be shown.

MID-WEST GLOVE COMPANY, INC., Chicago, Ill. (Booth 79), will exhibit the new and improved, patented Security x-ray protective gloves. X-ray films of various gloves of all makes, both new and used, may be viewed to determine if your present glove is giving adequate protection. For information on important personal protection, a visit to Security booth is suggested. Also on display will be a complete line of soft and safe Security x-ray protective aprons.

DONALD McELROY, Chicago, Ill. (Booth 39).

THE NORTH AMERICAN PHILIPS COMPANY, INC., Mt. Vernon, N. Y. (Booths 53-56): The North American Philips exhibit will feature image intensification. The equipment on display will include the new 11-inch Philips image intensifier, ideal for wide-field cineradiography, the UGX Patent Stand, and the amazing new Surgex for daylight fluoroscopy during surgery. Unique half-moon design plus 1000X brightness of the screen permits effortless use during hip pinning, reduction of fractures, neurosurgery, and foreign body localization.

NRD INSTRUMENT COMPANY, St. Louis, Mo., (Booths 66, 67, 68), will display a typical clinical radioisotope laboratory with live demonstrations of radioiodine uptake measurements, scanning procedures, blood volume, and other laboratory measurements. A Radioisotope Information Center will be staffed by consulting physicists to assist doctors interested in the use of radioisotopes.

THE NUCLEAR INSTRUMENT AND CHEMICAL CORPORATION, Chicago, Ill. (Booth 107).

PAKO CORPORATION, Minneapolis, Minn. (Booths 41-43), will exhibit manual x-ray film processing equipment, chemical handling accessories, and automatic replenishing equipment, as well as two new items recently added to the Pako line of x-ray products: the Pako Model 88 Silver Saver and the Pako Film Carrying Case.

PHYSICIANS TECHNICAL EQUIPMENT COMPANY, Milwaukee, Wisc. (Booth 104), will be exhibiting the following equipment: the well known Smit-Roentgen Heavy-Duty Lightweight Cassettes and the Smit-Roentgen "Golden Grids" of 65, 75, and 110 lines, available as grids only, as grid cassettes, and as grid channels; Auer intensifying screens, "Flash," "High-Speed," and "Detail-Standard"; High Wattage Monochromatic Darkroom Lighting, as well as other modern methods of darkroom illumination. To be displayed also are a new flexible exposure holder with and without built-in intensifying screens and the leakproof seamless and washable "Nova" protective gloves. A new orthodiagnostic attachment, a fluoroscopic depth gauge, and a radiographic localizer and pelvimeter will be featured, with the well known P.T.E. stereo-binoculars and a new Simultan-Multisection cassette.

PICKER X-RAY CORPORATION, White Plains, N. Y. (Booths 18-23, 78): Picker X-Ray extends a cordial invitation to stop at their booths. On display will be new developments of interest in the x-ray field. A separate exhibit of isotope measuring equipment will be introduced.

PROFEXRAY, INC., Maywood, Ill. (Booths 80 and 81).

RADIOLOGY, Detroit, Mich. (Booth 125): Representatives from the editorial office of Radiology, the official organ of the Radiological Society of North America, will be on hand to answer questions concerning the publication, offer suggestions to would-be contributors, and take subscriptions to the journal and the Cumulative Indexes.

RADIUM CHEMICAL COMPANY, INC., New York, N. Y. (Booth 14).

W. B. SAUNDERS COMPANY, Philadelphia, Penna. (Booth 116), will feature Dr. Meschan's new book *Roentgen Signs in Clinical Diagnosis*, which they regard as quite likely the most useful textbook of roentgenologic diagnosis ever published. It is especially valuable for its contribution to differential diagnosis.

SCHERING CORPORATION, Bloomfield, N. J. (Booth 94): A cordial invitation is extended to the members of the Radiological Society to visit the Schering exhibit, where new therapeutic developments will be featured. Schering representatives will be present to discuss these products.

SCHICK X-RAY COMPANY, INC., Chicago, Ill. (Booths 62-64), is featuring one of the new automatic processing machines of Elema-Schoenander of Stockholm, Sweden, manufacturers of such special equipment as high-speed film changers for angiographic procedures, 300-ma. mobile x-ray units, and the famous Lysholm CRT-4 skull unit.

FRANK SCHOLZ X-RAY CORPORATION, Boston, Mass. (Booth 93).

E. R. SQUIBB & SONS, New York, N. Y. (Booth 38); E. R. Squibb & Sons has long been a leader in development of new agents for the prevention and treatment of disease. The results of their diligent research are available to the medical profession in new products or improvements in products already marketed. At the Squibb booth, up-to-date information on these advances will be available.

STANDARD X-RAY COMPANY, Chicago, Ill. (Booths 9-12) will exhibit x-ray apparatus incorporating the latest developments and features required by modern technics. Attendants will be pleased to discuss individual requirements and problems and demonstrate equipment on exhibit.

CHARLES C THOMAS, PUBLISHER, Springfield, Ill. (Booth 37), will feature Pendergrass, Schaeffer, and Hodes: *The Head and Neck in Roentgen Diagnosis*, second edition; the four volumes of de Lorimier, Moehring and Hannan: *Clinical Roentgenology*; Hadley: *The Spine*; Etter: *Atlas of Roentgen Anatomy of the Skull*; Rubin: *The Lung as a Mirror of Systemic Disease*; Abrams and Kaplan: *Angiocardiographic Interpretation in Congenital Heart Disease*; Simullen: *Basic Foundations of Isotope Technique for Technicians*; Stenstrom: *Manual of Radiation Therapy*.

TRACERLAB, INC., Boston, Mass. (Booths 120-124).

UNITED STATES RADIUM CORPORATION, New York, N. Y. (Booth 72): The Radelin Division, United States Radium Corporation, is now celebrating its tenth year in the x-ray field. In recognition of the occasion, an informative brochure entitled *X-Ray Screens—Their Characteristics, Construction, Application and Care* will be distributed without charge at the booth. The complete line of Radelin x-ray products will be exhibited, with special emphasis on the new and improved aluminized intensifying screens.

VICTOREEN INSTRUMENT COMPANY, Cleveland, Ohio (Booth 61), will display the new version of the well-known Victoreen Condenser r-Meter. The new Model 570 features AC operation, rugged stable string suspension, fast and sure zeroing, increased intensity limits, and many other improvements. On exhibit also will be a new low-energy (down to 8 kev) survey meter, having a mylar window and

ranges of 10, 100, and 1,000 mr/hr. The popular Radocon, rate and total dose control instrument with various probe types, will be shown, together with survey meters, personal pocket chambers, and official civil defense survey equipment.

VOLK RADIO-CHEMICAL COMPANY, Chicago, Ill. (Booth 45)

WESTINGHOUSE ELECTRIC CORPORATION (X-Ray Division), Baltimore, Md. (Booths 1-6), extends an invitation to visit their exhibit of quality x-ray equipment and accessories, which will include: (1) Cine-Fluorex, for cinefluorography; (2) motor driven horizontal cassette changer with automatic reciprocating Bucky and universal cassette adapters; (3) Bariumette and Counter Top Bariumette; (4) a unique display of the latest in spot-film devices. Dave Mako, specialist in x-ray planning and layout for thirty-five years, will be on hand to discuss any layout problems which may arise.

THE WILLIAMS & WILKINS CO., Baltimore, Md. (Booth 77): Ross Golden's encyclopedic and authoritative *Diagnostic Roentgenology* has grown to such size that it is now necessary to issue it in three volumes rather than two. The 1956 renewal pages, *The Heart and Great Vessels* by Robert N. Cooley and Robert D. Sloan, comprise 380 pages with 195 illustrations. The complete set may be seen at the Williams & Wilkins exhibit.

WINTHROP LABORATORIES, 1450 Broadway, New York, N. Y. (Booth 28), is featuring the following radiodiagnostic media. Telepaque, a highly effective and well tolerated oral cholecystopaque medium, giving denser, clear-cut pictures of the gallbladder and, in a substantial number of cases, permitting visualization of the biliary ducts; Hypaque Sodium 50 per cent sterile solution (ampuls of 30 c.c.), a new, well tolerated highly radiopaque medium for excretion urography, containing 59.87 per cent iodine. Hypaque produces excretory uograms of a clarity approaching that usually obtained by the retrograde method.

WOLF X-RAY PRODUCTS, Inc., Brooklyn, N. Y. (Booths 46-49), will exhibit a complete line of x-ray accessories, both medical and dental. Of particular interest to the radiologist will be: (1) the Thermo Dryer, which dries twelve films within twenty-five minutes; (2) the File Stak, the most modern method for filing negatives; (3) the re-designed ten point quality developing hangers. A complete line of protective gloves and aprons will also be featured.

Available for distribution will be the second edition of Wolf's 100-page catalog No. 70, illustrating and describing in detail their complete line of manufactured products.

THE YEAR BOOK PUBLISHERS, INC., Chicago, Ill. (Booth 118).

ANNOUNCEMENT AND BOOK REVIEWS

ARKANSAS RADIOLOGICAL SOCIETY

At a recent meeting of the Arkansas Radiological Society the following officers were elected for the ensuing year: President, Dr. Edwin F. Gray, Little Rock; Vice-President, Dr. Joseph A. Norton, Little Rock; Secretary-Treasurer, Dr. E. A. Mendelsohn, Holt-Krock Clinic, Fort Smith.

CHICAGO ROENTGEN SOCIETY

Officers of the Chicago Roentgen Society for 1956-57 are R. Burns Lewis, M.D., President; Irvin F. Hummon, Jr., M.D., Vice-President; Arthur S. J. Petersen, M.D., 11406 Parnell Ave., Chicago 28, Secretary-Treasurer.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY

Newly elected officers of the Northeastern New York Radiological Society are as follows: Dr. Ira Rowson, Plattsburgh, President; Dr. Richard Batt, Glens Falls, Vice-President; Dr. Irving Van Woert, Jr., Albany Hospital, Albany, Secretary-Treasurer.

WEST VIRGINIA STATE RADIOLOGICAL SOCIETY

Officers of the West Virginia State Radiological Society for the coming year are: President, Dr. R. W. Powell, Fairmont; Vice-President, Dr. H. A. Shaffer, Morgantown; Secretary-Treasurer and Councilor to the American College of Radiology, Dr. W. Paul Elkin, 517 Medical Arts Bldg., Charleston. Dr. A. K. Butler, Wheeling, was elected to the Executive Council of the Society, and Dr. Karl Myers, Philippi, was named Alternate Councilor to the College of Radiology.

SOCIEDAD COSTARRICENSE DE RADIOLOGIA

The following members of the Sociedad Costarricense de Radiología have been elected to office: President, Dr. José Cabezas Duffner; Vice-President, Dr. Carlos de Céspedes Vargas; "Vocal," Dr. Carlos Cordero Chaverri; "Fiscal," Dr. Carlos A. Blanco Quesada; Treasurer, Dr. Enrique Mortúa Banchs; Secretary, Dr. James Fernández Carballo, Apartado VIII, San José, Costa Rica.

NINTH ANNUAL CONFERENCE ON ELECTRICAL TECHNICS IN MEDICINE AND BIOLOGY

As previously announced (see *RADIOLOGY* for May 1956) the Ninth Annual Conference on Electrical Technics in Medicine and Biology will meet

in New York City, Nov. 7-9, 1956. The tentative program includes Panel Discussions on Instrumentation for Cardiology, Methods and Standards for Measurement of Electron Beams, and Design of Instruments for Research in Artificial Respiration; an Evening Symposium on Nov. 7 with Lauriston S. Taylor lecturing on The Philosophy Underlying Radiation Protection; a session on Instrumentation in Medicine and Biology; and a field trip (Nov. 8) to Brookhaven National Laboratory. Dr. E. Dale Trout, General Electric Co., Milwaukee, Wisc., is the General Chairman.

A RADIOLOGIC MUSEUM PIECE

One of the first x-ray tubes employed by Wilhelm Konrad Roentgen was recently received in Washington, D. C., where it will be placed on permanent exhibition in the U. S. National Museum, Smithsonian Institution. The tube was purchased from a private owner in Germany and presented to the Smithsonian Institution by the General Electric Company's X-ray Department of Milwaukee, Wisc.

The newly acquired apparatus was Roentgen's third x-ray tube. His first two tubes are in Würzburg and Munich.

A REQUEST FROM THE NECROLOGY COMMITTEE

The Necrology Committee of the Radiological Society of North America again requests that information as to deaths occurring among the membership of the Society in the past year be forwarded to the Secretary, Dr. Donald S. Childs, 713 E. Genesee St., Syracuse 2, N. Y. If a duplicate notification could be made to the Editor of *RADIOLOGY*, earlier publication of death notices would be assured. The cooperation of all members of the Society is solicited in this effort to keep our records up to date.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

CANCER OF THE ESOPHAGUS AND THE STOMACH. By OWEN WANGENSTEEN, M.D., Professor of Surgery and Head of Department of Surgery, University of Minnesota Medical School, Minneapolis, Minn. A monograph of 144 pages, with 60 figures and 9 tables. Published by the American Cancer Society, Inc., New York (for free distribution), Second ed., 1956.

OBSERVATIONS ON KREBIOZEN IN THE MANAGEMENT OF CANCER. A. C. IVY, PH.D., M.D., Professor of Physiology and Head of the Department of Clinical Science, University of Illinois, and formerly Executive Director of the National Advisory Cancer Council and Director-at-large of the American Cancer Society; JOHN F. PICK, S.B., M.M., M.D., Head of Department of Plastic Surgery, Columbus Hospital, Chicago, and formerly Assistant Clinical Professor of Surgery, University of Illinois; W. F. P. PHILLIPS, M.D., Department of General Practice, St. Francis Hospital, Evanston, Ill. A volume of 88 pages of text, with 9 tables, 2 graphs, and 6 roentgenograms. Published by Henry Regnery Co., Chicago, 1956. Price \$2.50.

J.A.M.A. CLINICAL ABSTRACTS OF DIAGNOSIS AND TREATMENT. A volume of 662 pages. Published with the Approval of the Board of Trustees, American Medical Association, by the Intercontinental Medical Book Corporation, with Grune & Stratton, Inc., New York and London, 1956. Price \$5.50.

LES ULTRA-VIOLETS EN MÉDECINE. By JEAN MEYER, Ancien chef de clinique, Chef de Laboratoire à l'Hôpital Saint-Louis, and CLAUDE KELLERSHOHN, Professeur de physique médicale à la Faculté de Médecine de Nancy. A volume of 272 pages, with 126 illustrations. Published by G. Doin & Cie, 8, Place de l'Odéon, Paris VI^e, 1956. Price 2,500 fr.

CLINIQUE ET RADIOLOGIE DE LA COLONNE VERTÉBRALE NORMALE ET PATHOLOGIQUE. CONFRONTATION ANATOMO-PATHOLOGIQUE. By PROFESSEURS G. SCHMORL AND H. JUNGHANNS. French translation from the third German edition by Dr. J. L. Wolf Fried. A volume of 264 pages, with 403 figures. Published by G. Doin & Cie, 8, Place de l'Odéon, Paris VI^e, 1956. Price 5,800 fr. Note: Second German edition reviewed in Radiology 58: 744, 1952.

DAS SKELETT DES KINDES. ENTWICKLUNG, BILDUNGSFEHLER UND ERKRANKUNGEN. By DOZ. DR. W. SWOBODA, Assistent an der Univ.-Kinderklinik Wien. A volume of 184 pages, with 222 illustrations. Published by Georg Thieme Verlag, Stuttgart, 1956. Price DM 48.-

INTRAVENÖSE CHOLANGIOGRAPHIE, GRUNDLAGEN, TECHNIK, ERGEBNISSE. By PRIV.-DOZ. DR. TH. HORNYKIEWYTSCH, Giessen. With a Preface by Prof. Dr. R. Janker, Bonn, and a Foreword by Prof. Dr. H. Bohn, Giessen. A volume of 160 pages, with 185 illustrations. Published by Georg Thieme Verlag, Stuttgart, 1956. Price DM 54.-

Book Reviews

BORDERLANDS OF THE NORMAL AND EARLY PATHOLOGIC IN SKELETAL ROENTGENOLOGY. By PROF. DR. ALBAN KÖHLER. Tenth Edition, completely revised with reference to illustrations and to text by Dozent Dr. E. A. ZIMMER, Bern/Fribourg. English translation arranged and edited by JAMES T. CASE, M.D., D.M.R.E. (Cambridge), Professor Emeritus of Radiology, Northwestern University Medical School, Chicago; Director, Memorial Cancer Foundation, Santa Barbara, Calif. A volume of 724 pages, with 1,300 illustrations. Published by Grune & Stratton, Inc., New York and London, 1956. Price \$24.50.

Dr. James T. Case has performed a great service in making available an English translation of the latest edition of Köhler's famous "Borderlands" text. During the years that have elapsed since the original appearance of this work in 1910, nine subsequent editions have appeared in German and two in English. In this period it has been universally accepted as the authority on the normal and anomalous development of the osseous structures of the body. Though the original text has been rewritten and brought up to date by Zimmer in the Tenth German Edition, he has retained much of the "feel and flavor" of the earlier text. It is this edition that Dr. Case has translated and edited.

An introductory chapter on "Fundamental Considerations" relative to bone, cartilage, and the soft parts is followed by chapters covering the entire skeletal system. The descriptions and illustrations of atypical normal appearances which must be differentiated from pathologic changes are of inestimable value to the student and to the practicing radiologist. Many of the line drawings of previous editions have been replaced by good roentgenograms. There is an excellent bibliography, in which Dr. Case has incorporated pertinent references from the English and American literature.

To the radiologist already acquainted with this Bible of radiology, it will be welcome news that a new edition is now available. Those who are not familiar with it have a rare treat before them.

PRINCIPLES OF CHEST X-RAY DIAGNOSIS. By GEORGE SIMON, M.D., F.R.R., Assistant Director, X-ray Department, Brompton Hospital, London; Radiologist and Demonstrator, Radiological Anatomy, St. Bartholomew's Hospital, London; Curator of the Radiological Museum and Teacher of Radiology, The Institute of Diseases of the Chest, University of London. A volume of 184 pages, with 162 figures. Published by Butterworth & Co. Ltd., London, 1956. Price 50s.

The author of this text on diagnostic radiology of the chest has adopted a rather unusual plan of presentation, arranging his material under headings de-

scriptive of roentgen shadows rather than under clinical disease labels. He believes that the observer should first give a factual report of what he has seen and then try to translate his findings into terms of the underlying pathological process.

Following a brief introductory section in which the terms to be used are defined, is a chapter describing the shadows cast by normal structures in the chest and their variations which may sometimes be mistakenly interpreted as disease processes. Subsequent chapters are devoted to shadows of pathologic significance, as homogeneous shadows, linear shadows, and high-density shadows. All the thoracic structures are considered, including the bony cage. Special chapters are given over to bronchography, tomography and the time factor in diagnosis. Some hints on x-ray technic constitute an Appendix. The work contains 162 well chosen illustrations, but these do not wholly cover the text material.

The student and the radiologist who wish a ready source of reference when confronted by puzzling shadows on the chest film will find this short text of interest.

PEDIATRIC X-RAY DIAGNOSIS. A TEXTBOOK FOR STUDENTS AND PRACTITIONERS OF PEDIATRICS, SURGERY AND RADIOLOGY. By JOHN CAFFEY, A.B., M.D., Professor of Radiology, College of Physicians and Surgeons, Columbia University; Attending Pediatrician and Roentgenologist, Babies Hospital and Vanderbilt Clinic, New York City; Consulting Pediatrician, Grasslands Hospital, Westchester County, N. Y., and New Rochelle Hospital, New Rochelle, N. Y.; Consulting Roentgenologist, Orange Memorial Hospital, Orange, N. J.; Consultant in Pediatric Roentgenology, The New York Hospital, New York City. A volume of 1060 pages, with 1267 illustrations. Published by the Year Book Publishers, Inc., 200 East Illinois St., Chicago, Ill. Third Ed., 1956. Price \$28.00.

The new edition of Caffey's popular work on the roentgen diagnosis of pediatric conditions emphasizes the rapid progress that has been made in that field in the last few years. Though the second edition of the work appeared as recently as 1950, the addition of much new material and the rewriting of many chapters have been found necessary. The number of pages has been increased by about 200 and the number of illustrations by 250.

The present edition follows the plan of its predecessor, the contents being arranged under six general headings: I. The Head and Neck; II. The Thorax; III. The Abdomen and Gastro-intestinal Tract; IV. The Pelvis and Genito-urinary Tract; V. The Extremities; VI. The Vertebral Column.

A most notable addition to the earlier work is the section on congenital dysplasia and dislocation of the hip, including data from the author's recent studies

which fail to support some previous hypotheses. The chapters on congenital heart disease, megacolon, Perthes' disease, slipped femoral epiphyses, and on numerous other conditions have been rewritten.

This book continues to be the authoritative text on radiologic diagnosis in infancy and childhood. It is of primary importance to radiologists but will be valuable to any who are interested in the medical and surgical problems of this age group.

THERAPEUTIC USE OF ARTIFICIAL RADIOTRISOTOPES. Edited by PAUL F. HAHN, Ph.D., Cancer Research Laboratories, Nashville, Tenn. A volume of 414 pages, with numerous tables and illustrations. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price \$10.00.

Under the editorship of Paul F. Hahn, some twenty-nine authorities have contributed to this volume, which is designed to furnish a cross section of the efforts presently being carried out in the exploitation of artificial radioisotopes in therapy. The first six chapters are devoted to the physical, biological, and technical aspects of radioactive isotope therapy. They are required reading for any who are actively interested in the therapeutic use of these agents. The next nine chapters deal with specific clinical applications—radioactive phosphorus in the treatment of the leukemias and polycythemia vera, radioactive colloid therapy in chronic leukemia, radioiodine for thyrotoxicosis and thyroid carcinoma, radioactive colloidal gold in cervical and prostatic cancer, intraperitoneal applications chiefly for ovarian cancer, the treatment of pleural effusions, and isotope therapy of bladder tumors. These contributions come from men well qualified by training and experience to speak with authority on the subjects assigned them. The last four chapters deal with the practical problems of application, including a discussion of teletherapy with cobalt 60.

The text is well illustrated with photographs and charts, abundant references are printed at the end of each chapter, and a general index aids the reader in finding desired material. This book is of value to all interested in the study and use of radioisotopes.

BLAKISTON'S NEW GOULD MEDICAL DICTIONARY. A modern comprehensive dictionary of the terms used in all branches of medicine and allied sciences, including medical physics and chemistry, dentistry, pharmacy, nursing, veterinary medicine, zoology and botany, as well as medicolegal terms; with illustrations and tables. Editors: NORMAND L. HOERR, M.D., and ARTHUR OSOL, Ph.D. With the co-operation of an editorial board and 88 contributors. A volume of 1,464 pages, with 252 illustrations on 45 plates, 129 in color. Published by McGraw-Hill Book Company, Inc., New York, Second ed., 1956. Price \$11.50.

In the seven years which have passed since the appearance of Blakiston's New Gould Medical Dic-

tionary, itself a successor to an eminent series of similar works, many new words have come into more or less common usage and the implications of others have been modified or extended. These developments as they affect medicine in general and the various specialties have been taken into account in the preparation of the second edition of this useful dictionary. One hundred and seventy pages have been added, which makes room for a significant number of new entries. A notable feature is the inclusion among the tables at the end of the volume of a listing of radioactive isotopes employed medically, with details as to the half-life and diagnostic and therapeutic applications.

Like the first edition, this second edition of Blakiston's New Gould Medical Dictionary "can be recommended to all who speak, read, or write in terms of medicine and its sister sciences."

RHUMATOLOGIE CLINIQUE. By PIERRE P. RAVAULT, Professeur de Clinique Médicale à la Faculté de Lyon, Médecin de l'Hôpital E. Herriot, and GEORGES VIGNON, Professeur agrégé à la Faculté de Lyon, Médecin des Hôpitaux. A volume of 604 pages, with 180 figures. Published by Masson & Cie, 120, Boulevard Saint-Germain, Paris 6^e, 1956. Price 4,000 fr. (paper), 4,600 fr. (cloth).

This monograph represents a thorough clinical presentation of rheumatoid diseases, including material on etiology, pathogenesis, pathology, clinical signs, and therapy. It is amply illustrated with roentgenograms depicting the pertinent features of the principal types of arthritis.

In the first chapter there is a discussion of the differences between inflammatory and degenerative types of arthritis. This is followed by a consideration of the involvement of extra-articular tissues in rheumatic diseases. General hygienic therapy, drug therapy, and hormonal therapy are thoroughly discussed. Since gout presents so many different aspects, a separate chapter deals with that disease.

The second section of the book is entitled "Practical Rheumatology." The first two chapters are devoted to acute and chronic types of rheumatoid arthritis. Because of the special clinical aspects of vertebral lesions, rheumatoid spondylitis and other forms of arthritis involving the spine are given particular attention. The clinical aspects of arthritic involvement of the hip, knee, foot, shoulder, hand, and elbow are also considered under separate chapter headings. Sciatica and the various painful affections of the lower and upper extremities are also given special attention. The relation of the joints to various infectious, allergic, and metabolic states is thoroughly considered. Such miscellaneous conditions as scleroderma, caisson disease, tabes, and syringomyelia are also included.

The use of body-section roentgenography to enhance roentgenographic detail in areas such as the spine, shoulder, and hip is emphasized and illustrated with reproductions.

For those who read French, this is a thorough presentation of the clinical and roentgenologic aspects of rheumatology.

NOUVELLE ORIENTATION DU TRAITEMENT DU MAL DE POTT DE L'ADULTE. DIAGNOSTIC PRÉCOCE. TRAITEMENT MÉDICO-CHIRURGICAL. By S. DE SÈZE AND J. DEBEYRE, with the collaboration of SIMONE RAMPON, CL. GUÉRIN, and CL. MOREAU. A monograph of 102 pages, with numerous illustrations. Published by Masson & Cie, 120, Boulevard Saint-Germain, Paris 6^e, 1956. Price 900 fr.

This monograph, one of a series designed to acquaint the practitioner with current thinking on timely subjects, deals with the diagnosis and treatment of Pott's disease in the adult. The clinical and radiologic aspects of the early diagnosis and the various complementary procedures are given adequate discussion. This is followed by the authors' views on medical and surgical management.

Without question, this little volume should be of great interest to the clinician concerned with Pott's disease. It is of more limited appeal to the radiologist.

The printing and illustrations are excellent.

In Memoriam

H. A. THOMAS, M.D.

1879-1956

Dr. Herbert A. Thomas, Chief of the X-Ray Department of Memorial Hospital, Lima, Ohio, died on August 17 after a brief illness. Born in Ebensburg, Penna., Dr. Thomas was almost a life-long resident of Lima. He is believed to have been the first practitioner of radiology in that area, and was responsible for the establishment of the X-Ray Department at Lima City Hospital in 1913. He received his A.B. degree from Adelbert College in Cleveland in 1903, was graduated from the medical school of Western Reserve University in 1909, and served his internship at Lakeside Hospital, Cleveland. Dr. Thomas was a member of the Radiological Society of North America, the American Academy of Medicine, the Ohio State Medical Association, the Allen County Academy of Medicine, and the Half-Century Club of Adelbert College, Western Reserve University. He is survived by his wife, the former Annabel Alling, two children, and four grandchildren.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N.Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Theodore R. Miller, M.D., 139 E. 36 St., New York 16, N.Y.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stromach, 20 N. Wacker Dr., Chicago 6.

ASSOCIATION OF UNIVERSITY RADIOLOGISTS. *Secretary-Treasurer*, David M. Gould, M.D., University of Arkansas Medical Center, Little Rock, Ark.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, T. Leututia, M.D., 10 Peterboro, Detroit 1, Mich.

SOCIETY OF NUCLEAR MEDICINE. *Secretary*, R. G. Moffat, M.D., 2656 Heather St., Vancouver 9, Canada.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. A. Meadows, Jr., M.D., Medical Arts Bldg., Birmingham 5.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James J. Riordan, M.D., 550 W. Thomas Rd., Phoenix. Annual meeting with State Medical Association; interim meeting in December.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, E. A. Mendelsohn, M.D., Holt-Krock Clinic, Fort Smith. Meets quarterly.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Austin R. Wilson, M.D., 540 N. Central Ave., Glendale 3.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Lewis J. Peña, M.D., 405 N. Bedford Dr., Beverly Hills. Meets monthly, second Wednesday, Los Angeles County Medical Association Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, H. B. Steward, Jr., M.D., 2920 Capitol Ave., Sacramento. Meets last Monday of each month, September to May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually at time of California State Medical Association convention.

RADIOLOGICAL SOCIETY OF SOUTHERN CALIFORNIA. *Secretary-Treasurer*, Robert B. Engle, M.D., 318B W. California St., Pasadena.

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary*, C. W. Bruner, M.D., 2456 Fourth Ave., San Diego 1. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary*, Howard L. Steinbach, M.D., University of California Medical Center, San Francisco 22. Meets quarterly, at Grison's Steak House.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, Thomas N. Foster, M.D., 630 E. Santa Clara St., San Jose. Meets monthly, second Wednesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, James T. English, M.D., 2000 Van Ness Ave., San Francisco 9. Meets third Thursday at 7:45, Lane Hall, Stanford University Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Dorr H. Burns, M.D., 1776 Vine St., Denver. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary-Treasurer*, Ralph J. Littwin, M.D., Bristol Hospital, Bristol. Meets bimonthly, second Wednesday.

District of Columbia

RADIOLOGICAL SECTION DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary-Treasurer*, Melvin O. Goodman, M.D., 1930 K St., N.W., Washington 6. Meets third Wednesday, January, March, May, and October, 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, C. Robert DeArmas, M.D., 135 Broadway, Daytona Beach. Meets in April and in October.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, André S. Capi, M.D., 300 N. 20th Ave., Hollywood, Fla. Meets monthly, third Wednesday, 8:00 P.M., at Mercy Hospital.

NORTH FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Marvin Harlan Johnston, M.D., Five Points Medical Center, Jacksonville 4. Meets quarterly, March, June, September, and December.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Bert H. Malone, M.D., 1406 Reynolds St., Brunswick. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Herbert M. Olnick, M.D., 417 Persons Bldg., Macon, Ga. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Wm. F. Hamilton, Jr., M.D., University Hospital, Augusta. Meets first Thursday of each month.

Hawaii

RADIOLOGICAL SOCIETY OF HAWAII. *Secretary-Treasurer*, Richard D. Moore, M.D., St. Francis Hospital, Honolulu 17. Meets third Monday of each month.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary-Treasurer*, R. Arthur S. J. Petersen, M.D., 11406 Parnell Ave., Chicago 28. Meets at the Sheraton Hotel, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLoGY. *Secretary*, George E. Irwin, Jr., M.D., 427 N. Main St., Bloomington.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, Chester A. Stayton, Jr., M.D., 313 Hume-Mansur Bldg., Indianapolis 4. Meets twice a year, first Sunday in May and during fall meeting of State Medical Association.

TRI-STATE RADIOLOGICAL SOCIETY (Southern Indiana, Northwestern Kentucky, Southeastern Illinois). *Secretary-Treasurer*, Robert E. Beck, M.D., 600 Mary St., Evansville, Ind. Meets last Wednesday, October, January, March, and May, 8:00 P.M., at the Elks' Club, Evansville, Ind.

Iowa

IOWA RADIOLOGICAL SOCIETY. *Secretary*, James T. McMillan, M.D., 1104 Bankers Trust Bldg., Des Moines. Meets during annual session of State Medical Society, and in the Fall.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, G. S. Ripley, Jr., M.D., W. Iron Ave., Salina. Meets in the Spring with the State Medical Society and in the Winter on call.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary*, David Shapiro, M.D., Jewish Hospital, 217 E. Chestnut St., Louisville 6. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

Louisiana

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets second Tuesday of each month.

RADIOLOGICAL SOCIETY OF LOUISIANA. *Secretary-Treasurer*, W. S. Neal, M.D., 602 Pere Marquette Bldg., New Orleans.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, W. R. Harwell, M.D., 608 Travis St. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Walter A. Russell, M.D., Augusta General Hospital, Augusta. Meets in June, October, December, and April.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, Nathan B. Hyman, M.D., 1805 Eutaw Place, Baltimore 17. Meets third Tuesday, September to May.

MARYLAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Nathan B. Hyman, M.D., 1805 Eutaw Place, Baltimore 17.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, E. F. Lang, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

UPPER PENINSULA RADIOLOGICAL SOCIETY. *Secretary*, Arthur Gonty, M.D., Menominee. Meets quarterly.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, O. J. Baggensost, M.D., 1953 Medical Arts Bldg., Minneapolis 2. Meets three times a year, in Fall, Winter, and Spring.

Mississippi

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Packer, M.D., 621 High St., Jackson. Meets monthly, on third Tuesday, at 6:30 P.M., at the Hotel Edwards, Jackson.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary-Treasurer*, D. R. Germann, M.D., University of Kansas Medical Center, Kansas City 3, Kans. Meets last Friday of each month.

GREATER ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Sam J. Merenda, M.D., 45 Berry Road Park, Glendale, Mo. Meets on fourth Wednesday, October to May.

Montana

MONTANA RADIOLOGICAL SOCIETY. *Secretary*, John Stewart, M.D., Billings Clinic, Billings. Meets annually.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James F. Kelly, Jr., M.D., 816 Medical Arts Bldg., Omaha. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Thomas J. Crowe, M.D., 53 Center St., Northampton, Mass. Meets second Friday of October and April.

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, Raymond A. Dillon, M.D., 24 Wedgemere Ave., Winchester, Mass. Meets monthly on third Friday, October through May, at the Hotel Commander, Cambridge, Mass.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnson, M.D., 127 Washington St., Keene.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, George G. Green, M.D., 601 Grand Ave., Asbury Park. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabethtown.

New York

BROOKLYN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Theodore Kamholz, M.D., 152 Clinton St. Meets first Thursday, October through May.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Charles Bernstein, M.D., 685 Delaware Ave., Buffalo. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 2. Meets in January, May, and October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Solomon Maranov, M.D., 1450 51st St., Brooklyn 19. Meets fourth Thursday, October to April (except December), at 9:00 P.M., Kings County Medical Bldg.

NASSAU RADIOLOGICAL SOCIETY. *Secretary*, Frances M. Behrendt, M.D., 19 Clinton Rd., Garden City, N.Y. Meets second Tuesday, February, April, June, October, and December.

NEW YORK ROENTGEN SOCIETY. *Secretary*, John A. Evans, M.D., 525 E. 68th St., New York 21.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Irving Van Woert, Jr., M.D., Albany Hospital, Albany. Meets in the capital area second Wednesday, October, November, March, and April. Annual meeting in May or June.

RADIOLOGICAL SOCIETY OF NEW YORK STATE. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo. Meets annually with the State Medical Society.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, T. Paul Guest, M.D., 277 Alexander St., Rochester. Meets at Strong Memorial Hospital, 8:15 P.M., last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arnold Myron Wald, M.D., 406 Boston Post Road, Port Chester. Meets third Tuesday of

January and October and at other times as announced.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, William H. Sprunt, M.D., North Carolina Memorial Hospital, Chapel Hill, N.C. Meets in April and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, Marianne Wallis, M.D., Minot. Meets in the Spring with State Medical Association; in Fall or Winter on call.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Hannan, M.D., 10515 Carnegie Ave., Cleveland 6.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arthur R. Cohen, M.D., 41 S. Grant Ave., Columbus. Meets second Thursday, October, November, January, March, and May, 6:30 P.M., Fort Hayes Hotel, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arthur S. Tucker, M.D., 2065 Adelbert Road, Cleveland 6. Meets at 7:00 P.M., fourth Monday, October, November, January, February, March, and April, at Tudor Arms Hotel.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Richard J. Neubauer, M.D., 831 Carew Tower, Cincinnati 2. Meets first Monday, September to June, at Cincinnati General Hospital.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, W. S. Koller, M.D., 60 Wyoming St., Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sol Wilner, M.D., Medical Arts Bldg., Tulsa.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, N. L. Bline, M.D., 210 Jackson Tower, Portland 5. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club, Portland.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert Hanf, M.D., 807 South Auburn, Kennewick, Wash. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Walter P. Bitner, M.D., 234 State St., Harrisburg. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, Roderick L. Tondreau, M.D., 3400 Spruce St., Philadelphia 4. Meets first Thursday of each

month at 5:00 p.m., from October to May, in Thompson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Norman Tannehill, M.D., 601 Jenkins Bldg., Pittsburgh 22. Meets monthly, second Wednesday, at 6:30 p.m., October to May, at the Hotel Roosevelt.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John H. Freed, M.D., 4200 E. Ninth Ave., Denver 7, Colo. Next meeting Aug. 16-18, 1956, at Denver.

South Carolina

SOUTH CAROLINA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Samuel W. Lippincott, M.D., 103 Rutledge Ave., Charleston. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Donald J. Peik, M.D., 303 S. Minnesota Ave., Sioux Falls. Meets during annual meeting of State Medical Society.

The Southwest

SOUTHWESTERN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Gordon L. Black, M.D., 1501 Arizona Bldg., El Paso.

Tennessee

MEMPHIS ROENTGEN SOCIETY. *Secretary*, Dan C. Gary, M.D., 36 S. Bellevue, Memphis 4. Meets first Monday of each month at John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, George K. Henshall, M.D., 311 Medical Arts Bldg., Chattanooga 3. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH RADIOLOGICAL CLUB. *Secretary*, Albert H. Keene, M.D., 3707 Gaston Ave., Suite 116, Dallas. Meets monthly, third Monday, 6:30 p.m., at the Greater Fort Worth International Airport.

HOUSTON RADIOLOGICAL SOCIETY. *Secretary*, Leslie L. Lemak, M.D., 616 Medical Arts Bldg., Houston 2. Meets fourth Monday at the Doctors' Club.

SAN ANTONIO-MILITARY RADIOLOGICAL SOCIETY. *Secretary*, Hugo F. Elmendorf, Jr., M.D., 730 Medical Arts Bldg., San Antonio 5, Texas. Meets at Brook Army Medical Center, second Wednesday of each month.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City 1. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., 1308 Manteo St., Norfolk 7.

Washington

WASHINGTON STATE ROENTGEN SOCIETY. *Secretary-Treasurer*, Eva L. Gilbertson, M.D., 1317 Marion St., Seattle 4. Meets fourth Monday, September through May, at 610 Pine St., Seattle.

West Virginia

WEST VIRGINIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. Paul Elkin, M.D., 515-519, Medical Arts Bldg., Charleston. Meets concurrently with annual meeting of State Medical Society, and at other times as arranged by Program Committee.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Jerome L. Marks, M.D., 161 W. Wisconsin Ave., Milwaukee 1. Meets monthly on fourth Monday at the University Club.

SECTION ON RADIOLOGY, STATE MEDICAL SOCIETY OF WISCONSIN. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee 2. Meets in October with State Medical Society.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursday at 4 p.m., September to May, Service Memorial Institute.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. W. Moir, M.D., Sheboygan Memorial Hospital, Sheboygan.

Puerto Rico

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary-Treasurer*, Dr. R. B. Díaz Bonnet, Suite 504, Professional Bldg., Santurce, P.R.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, Guillaume Gill, M.D.; *Associate Honorary Secretary-Treasurer*, Norman M. Brown, M.D. *Central Office*, 1555 Summerhill Ave., Montreal 25, Quebec. Meets in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTRO-RADIOLOGIE MÉDICALES. *General Secretary*, Ls Ivan Valée, M.D., Hôpital Saint-Luc, 1058 rue St-Denis, Montreal 18. Meets third Saturday of each month.

L'ASSOCIATION DES RADIOLOGISTS DE LA PROVINCE DE QUÉBEC. *ASSOCIATION OF RADIOLOGISTS OF THE PROVINCE OF QUEBEC.* *Secretary*, Isadore Sedlezky, M.D., 3755 Cote St., Catherine Road. Meets four times a year.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPÍA DE CUBA. *Secretary*, Dr. Rafael Gomez Zaldivar. Offices in Hospital Mercedes, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA. A. C. *Headquarters*, Calle del Oro, Num. 15, Mexico 7, D. F. *Secretary General*, Dr. Guillermo Santin. Meets first Monday of each month.

PANAMA

SOCIEDAD RADIOLÓGICA PANAMEÑA. *Secretary-Editor*, Luis Arrieta Sánchez, M.D., Apartado No. 86, Panama, R. de P.

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AN INNOVATION

It has been suggested from time to time that there be included, along with the titles and references for the articles abstracted in *RADIOLOGY*, the addresses of the authors. Beginning with the present issue, an attempt is being made to comply with this suggestion. The matter is less simple, however, than it might appear. In some instances no address appears on the original paper; in others only the name of the institution from which the report originates is given, even though the author's connection with that institution may have terminated. Under these circumstances, we have done the best we could.

Where the author's personal address has been available, it has been used; otherwise the name of the hospital or university with which he is presumably associated is supplied. In the case of multiple authorship, the address given is usually that of the first author, preceded by initials to avoid any possible misunderstanding. If no initials are given, the address may be assumed to be that of the authors as a group.

While no guarantee as to 100 per cent accuracy can be offered, it is hoped that this innovation will add to the usefulness of the Abstract Section of *RADIOLOGY*.

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Calcification of the Basal Ganglia of the Brain. Victor Szyrynski. *J. Canad. A. Radiologists* 6: 68-71, December 1955. (297 Laurier Ave., Ottawa, Ont.)

An interesting case of idiopathic calcification of the dentate, lenticular, and pineal complexes demonstrated roentgenologically is reported. The changes were symmetrical and remained unaltered for two and a half years. Clinically there was no evidence of hypoparathyroidism or other disturbance in calcium metabolism. The patient was of low average intelligence with some hysterical tendencies and a number of neurological signs suggestive of a mild parkinsonism.

While calcification of the vessels in the basal ganglia is not an uncommon histopathologic finding in patients past middle age, it is rarely so pronounced as to be visible roentgenologically. Forty-three cases have been reported in the literature.

The author cites briefly a case of calcification of the choroid plexus to illustrate the topographical differences between these two radiologic syndromes of intracranial calcification.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Neurologic Manifestations of Nasopharyngeal Tumors. Herbert E. Rosenbaum and William B. Seaman. *Neurology* 5: 868-874, December 1955. (H. E. R., 634 N. Grand Blvd., St. Louis 3, Mo.)

Two per cent of all cancers occur in the nasopharynx, most of them arising in the fossa of Rosenmüller, which lies directly beneath the foramen lacerum. This predisposes to involvement of the nervous system, which is said to occur in more than 50 per cent of the cases. The presenting symptoms are neurologic in some 25 per cent, consisting usually of steady unilateral facial pain or ear pain, often with one or more cranial nerve palsies.

Lateral skull roentgenograms may show a nasopharyngeal soft-tissue mass, and sometimes bony destruction of the floor of the sella. The destruction of the base of the dorsum sella with the free portion remaining intact presents a rather distinctive appearance. On the submento-vertex view one occasionally sees destruction of the mesial portion of the great wing of the sphenoid, especially in the region of the foramen ovale. The petrous apex may also show involvement.

In differential diagnosis the patient's age plus biopsy usually serve to distinguish nasopharyngeal lymphoid hyperplasia. Nasopharyngeal fibroma is limited to adolescent males and never causes neurological signs. Solitary nasopharyngeal myeloma, pituitary tumor, and craniopharyngioma may also need to be considered in differentiation.

Twenty-four cases are reviewed in this presentation. Ten of them were said to have positive roentgenographic findings, 3 were said not to have positive x-ray findings, and in 11 there was no comment. Reference is made to Jönsson (*Acta radiol.* 22: 651, 1941. *Abst. in Radiology* 40: 102 1943), who was able to detect the presence of 66 of 79 malignant nasopharyngeal tumors by the roentgen changes.

Seven roentgenograms; 2 drawings; 1 diagram; 1 table.

DON E. MATTHIESSEN, M.D.
Phoenix, Ariz.

Clinical Contribution to the Problem of Foreign Bodies in the Air and Upper Food Passages. R. Züllig. *Schweiz. med. Wochenschr.* 85: 1238-1242, Dec. 17, 1955. (In German) (Otolaryngologischen Klinik den Kantonsspitals St. Gallen, Switzerland)

This paper analyzes 115 cases of foreign bodies, of which 16 were in the hypopharynx and larynx, 26 in the airways distal to the glottis, and 73 in the esophagus. Forty-six per cent of those in the air passages were in children two years of age or under, while 51 per cent of those in the alimentary tract were in the age group from fifteen to sixty. In 6 per cent of the cases, pre-existing disease played an etiologic role (esophageal carcinoma, scarring after surgery or the ingestion of caustics, epilepsy). Seven psychiatrically abnormal patients were among the adults and 3 of these had attempted suicide. Excepting a case in which a dental prosthesis was retained in a bronchus for almost two years, the average period of retention in the air passages was 9.1 days.

The radiological identification depends considerably upon technical factors. Penetrating roentgenograms may show even peas or nuts, while much denser foreign bodies can be obscured if tightly embedded in soft tissues. Negative air-contrast may at times demonstrate a relatively radiolucent object. In 55 cases of this series the foreign bodies were apparent roentgenographically (16 in the airways, 32 in the esophagus, and 7 in the hypopharynx and larynx), while 48 could not be identified (8 in the hypopharynx and larynx, 31 in the esophagus, 9 in the airways).

Endoscopic removal is most often successful, but occasionally surgical intervention may become necessary. Among the 115 cases there were 2 deaths, both in infants with foreign bodies in the airways. The complications were more frequent in the airway group, perhaps because of the longer retention time.

Also reported are 16 bronoscopies for suspected foreign body and 23 esophagoscopies.

Five cases (including the 2 with fatal issue) are reported in detail. In 1 infant the ossification center of the sternal manubrium was interpreted as a foreign body, but this diagnosis was later ruled out by barium swallow and oblique roentgenograms.

Four roentgenograms; 4 tables.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

THE CHEST

Acute Infections of the Chest in General Practice. A. Batty Shaw and John Fry. *Brit. M. J.* 2: 1577-1586, Dec. 31, 1955. (A. B. S., Guy's Hospital, London, S.E. 1, England)

Eighty cases of severe acute infectious chest disease occurring in general practice were studied from the aspects of bacteriology, virology, serology and hematology. Patients were classified clinically as having influenza with chest complications (22), bronchitis (16), and pneumonia (12).

Seventy-three of these patients were examined roentgenographically. Relevant pulmonary abnormalities were detected in 73, or 48 per cent. The earlier the roentgenogram was obtained, the higher was the percentage of abnormalities, (78 per cent in the first week,

24 per cent in the second to fourth weeks). It is recognized, however, that the more severely ill patients were examined earlier in the course of the disease. Segmental pneumonias were the largest group found (19 cases). There were 10 lobular pneumonias, and 4 lobar pneumonias. A single case of bronchogenic carcinoma and one of spontaneous pneumothorax were discovered.

Radiography was the most helpful of the investigations undertaken. It enabled a correlation to be made with the clinical findings, and it also served to exclude other types of disease. It was of special importance after clinical recovery to ensure that resolution was complete.

Three graphs; 7 tables.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

The Diagnostic Problem of Peripheral Pulmonary Lesions. Saul Heiser and Jerome H. Shapiro. *Dis. of Chest* 28: 681-686, December 1955. (S. H., 3741 Stocker St., Los Angeles, Calif.)

There are two factors contributing to delay between the detection of a lesion suspicious of peripheral lung tumor and the time when the patient is subjected to operation. The first is procrastination by the patient before he consults a physician. This paper deals with the second factor, namely, the delay on the part of the physician who studies the lesion or chooses the course of "watchful waiting."

The authors' material comprised 78 patients with obscure peripheral pulmonary lesions who were operated upon. The investigations undertaken consisted of radiography (including extrathoracic studies in a search for a primary lesion), sputum examinations for acid-fast organisms, bronchoscopy and cytologic studies. The time of hospitalization during which such procedures were undertaken varied from two days to two months. The average was about two weeks. Of the 78 patients in the series, 55 proved to have bronchial carcinoma.

Chest roentgenography is, of course, imperative as an aid to diagnosis, but extrathoracic roentgen studies, made in 28 cases in this series, were in no instance successful in demonstrating a primary tumor outside the lungs. Bronchoscopy proved the diagnosis in only 12 of the 55 cases, which is understandable because of the peripheral location of the lesions. Thirty-four patients had repeated sputum examinations (up to 22 per patient) for acid-fast bacilli, and in none were positive smears or cultures obtained, though 8 proved to have tuberculosis on thoracotomy. In 33 of the 55 cases of carcinoma Papanicolaou smears were obtained, either from bronchial washings or sputum, but were reported positive in only 7, and questionable in 6. Questionable cytologic findings were also reported in 3 of 13 non-carcinomatous patients.

Of the 78 patients operated upon, 55 had bronchial carcinoma, 1 lymphoblastoma, 3 bronchial adenoma, 3 hamartoma, 1 chondroma, 1 a bronchogenic cyst, 1 a pericardio-coelomic cyst, 11 granuloma (tuberculosis), 2 organizing pneumonia.

The authors conclude that the low percentage of positive returns in the diagnostic procedures appears outweighed by the disadvantages of delaying definitive therapy and prolongation of hospitalization.

ALEXANDER R. MARGULIS, M.D.
University of Minnesota

Pulmonary Apical Herniations. Nathan M. Fenichel and Bernard S. Epstein. *Arch. Int. Med.* 96: 747-751, December 1955. (N. M. F., 1374 Union St., Brooklyn 13, N. Y.)

Nineteen cases of pulmonary apical herniation are reported. Of the 19 patients, 10 were women. Their ages varied from forty-five to eighty-four years, the average being sixty-six. All but 2 patients had emphysema, and all but 4 presented with a history of chronic cough for many years. The latter 4 patients had emphysema without pulmonary symptoms. In 12, emphysema was associated with chronic bronchitis or bronchiectasis and in 1 it was a sequel of forty years of bronchial asthma. Five patients had a supraclavicular bulge before coughing or performing the Valsalva maneuver; the expansion became much greater after either procedure.

Roentgen studies, carried out on normal subjects and on many of the emphysematous patients, included postero-anterior roentgenograms in inspiration and expiration, apical lordotic views, and lateral neck exposures. Those found of greatest value for demonstrating apical herniation were the lateral neck films. They were the only ones which clearly showed the cupolas of the lungs above the level of the clavicles. In none of the other projections were the authors able to visualize pulmonary parenchyma projecting into the supraclavicular fossae. Their data, therefore, are based mainly on lateral cervical views, made at rest, midway in inspiration, and in exactly the same position after deep inspiration followed by forced expiration against the closed glottis with the nostrils blocked (the classical Valsalva maneuver).

Comparative roentgenologic observations of the trachea and supraclavicular fossae were made at rest and during the Valsalva maneuver in 8 patients. Roentgenograms at rest showed slight or no apical protrusion into the supraclavicular fossae and normal trachea. With strain, however, the pulmonary apices assumed a prominent supraclavicular position as air-containing bulging shadows. This phenomenon was variable and appeared to be related to the duration and force of the strain. In some instances the trachea was displaced anteriorly. The intracervical trachea dilated perceptibly and buckled anteriorly. The distention was particularly prominent in the posterior portion, where the cartilaginous rings become discontinuous.

Five roentgenograms; 2 photographs.

Differential Roentgenologic Semeiology of Cavities in the Lung Parenchyma. Nicola De Serio. *Arch. di radiol.* 30: 19-56, Fasc. I, 1955. (In Italian) (Divisione Radiologica del Centro Tumore di Bari, Bari, Italy)

Lateral or oblique views of the chest (sometimes body-section roentgenograms) help to distinguish lung cavities from chance configurations (pseudocyst, pseudoabscess, pseudocavity) seen in association with inflammatory processes or soft-tissue injury. The cavities may be of cystic origin, as in the following conditions: (1) echinococcosis; (2) bullous emphysema, localized or diffuse, appearing in an elastically weakened parenchyma in the presence of valvular bronchial stenosis (neoplasm, foreign body, lymphadenopathy, mucous plug, acute or subacute pneumonitis); (3) cystic parenchymal pneumopathies of congenital origin, including solitary cysts (pneumatocele) and polycystic (fibrocystic) lungs; (4) cystic bronchiectatic pneumopathies, either congenital or acquired.

True pulmonary excavations can be produced by (a) tuberculosis, (b) syphilis, (c) fungous disease (d) pneumoconiosis, (e) gangrenous abscess, and (f) neoplasm. While the roentgenologic appearance (detailed in the paper) often gives pertinent help in the differential diagnosis, clinical, bacteriological, and sometimes even histological correlation are required for a definite interpretation.

Twenty roentgenograms; 2 tables.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

The Postoperative Status of the Dependent Lung.
Robert L. Lambert, George Willauer, and Frederick W. Dasch. *J. Thoracic Surg.* **30**: 713-718, December 1955. (R. L. L., Colonial Village, Wayne, Penna.)

Because the majority of lung operations are performed in the lateral decubitus position, the underlying lung is usually compressed by the weight of the mediastinal structures and by the weight of the abdominal viscera pressing against the diaphragm. The body weight also restricts motion of the dependent hemithorax. These factors reduce alveolar ventilation and favor the accumulation of secretions. If chest films are made at this time, they will show increased density in the dependent lung, varying from patchy infiltration to complete opacity, along with freedom from such changes in the exposed lung.

Films obtained immediately after thoracic surgery in 33 patients were reviewed in this study. Films were made in various positions; and the rate with which the changes disappeared upon postural change from decubitus to supine and vice versa was impressive.

Twelve roentgenograms.

DON E. MATTHIESSEN, M.D.
Phoenix, Ariz.

Malignant Pulmonary Lesion with Calcification. I. Sedlezky. *J. Canad. A. Radiologists* **6**: 65-67, December 1955. (3755 Ste. Catherine Rd. 26, Montreal)

A single case is reported which proves to be an exception to the rule of thumb that a lung lesion showing calcification is not malignant. In this case malignant change occurred in a hamartoma, producing an osteochondrosarcoma. Only a very few such cases have been presented.

The lesion (in the left hilus) was observed over a period of two and a half years. Nine months after its discovery, it showed no change roentgenographically, but on examination fifteen months later there had been some increase in size and central calcification was demonstrated. The patient complained of cough and expectoration at that time, and these continued for the next seven months, until pneumonectomy was done. By this time the left bronchus was completely obstructed but not invaded by the tumor. (No explanation is offered for the long delay in surgery.)

Four roentgenograms; 1 photograph.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Intermittent Pulmonary Atelectasis in the Diagnosis of Bronchial Adenoma. F. De Simone and R. Lucarelli. *Arch. di radiol.* **30**: 277-295, Fasc. II, 1955. (In Italian) (Istituto di Radiologia Medica, dell'Università di Roma)

Prior to complete atelectasis, the symptomatology of bronchial adenoma is mainly due to associated inflam-

matory episodes. Definite diagnosis requires histologic examination (bronchoscopy!), but at this stage detection is largely a roentgenologic problem. In this respect, the authors emphasize the importance of *intermittent* (transient) *atelectasis*, especially when accompanied by localized bullous emphysema, the latter being otherwise rather uncommon in the age group showing the maximum incidence of bronchial adenoma (under forty). Body-section roentgenography is also indicated, since it can visualize the dense tumor pluging the radiolucent, ribbon-shaped bronchus.

A case is reported in which left pneumonectomy was successfully performed in a 44-year-old female, after two years of respiratory symptomatology. There had been no evidence of recurrence three years after surgery.

Twelve roentgenograms; 2 photomicrographs.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Nocardiosis. Clinical, Bacteriologic and Pathological Aspects. Lyle A. Weed, Howard A. Andersen, C. Allen Good, and Archie H. Baggenstoss. *New England J. Med.* **253**: 1137-1143, Dec. 29, 1955. (Mayo Foundation, Rochester, Minn.)

Clinically, pulmonary nocardiosis resembles many types of chronic pneumonitis caused by other microbial agents. It is usually ushered in with fever and a cough productive of thick, tenacious, mucopurulent or frankly purulent sputum. The x-ray examination is useful in revealing the presence of disease in the lung, in determining its location and extent, and in following its course, but in no way can it enable the physician to determine the specific etiologic agent. In the early cases roentgenograms show single or multiple areas of non-specific pneumonitis, with subsequent dissemination or abscess formation, but such a pattern may be produced also by other infectious processes. The differential diagnosis must include tuberculosis, histoplasmosis, acute bacterial pneumonia, and possibly primary carcinoma. There is no improvement following treatment with the currently used antibiotics, but sulfadiazine has proved effective.

In 6 of the 7 cases reported by the authors, the primary infection appeared to be in the lungs. In 3 cases there were metastatic lesions in the brain. Laboratory findings are those of any severe infection: anemia, leukocytosis, and an increased sedimentation rate. Diagnosis can be made only by demonstration of the organism in smear or culture. Since, however, *Nocardia* is a common contaminant of foods, it must appear in cultures repeatedly, without the presence of other known pathogens, to warrant a diagnosis of nocardiosis. The microorganisms grow as fine, branching filaments that may fragment into bacillary or coccoid forms.

Grossly the lesions produced take the form of abscesses, which are usually multiple and confluent and difficult to differentiate from suppuration due to the more common pyogenic organisms or even caseous tuberculosis. There is extensive necrosis of tissue, with little or no surrounding reaction to suggest encapsulation. At most there is a loose, incomplete wall of granulation trying to localize the lesion. Neighboring daughter abscesses are common.

Nocardiosis should enter into the differential diagnosis of any pneumonia that fails to respond to antibiotic therapy when the tubercle bacillus and other specific microorganisms are absent. This is especially

important since early therapy with sulfadiazine appears to prevent metastatic abscesses, particularly in the brain.

Six roentgenograms; 2 photomicrographs; 2 photographs.

SAUL SCHEPP, M.D.
Boston, Mass.

Unusual X-Ray Appearances in Hodgkin's Disease. S. Holesh. Proc. Roy. Soc. Med. 48: 1049-1052, December 1955. (Diagnostic Radiological Department, Westminster Hospital, London, England)

An analysis is made of the roentgen findings in 300 cases of Hodgkin's disease seen in the radiotherapy clinic at Westminster Hospital during the past fifteen years.

The roentgen findings of mediastinal lymphadenopathy may be caused by many diseases. Although there is no characteristic x-ray appearance, Hodgkin's disease tends to involve the paratracheal and bifurcation groups more than the other bronchial groups, whereas sarcoidosis and tuberculosis, in recently tuberculinized patients, affect mainly the bronchial groups. Also, sarcoidosis and tuberculosis are nearly always bilateral, while Hodgkin's disease in its early stage is often unilateral and in many instances produces a much larger mass. These large unilateral lesions may simulate a dermoid, substernal thyroid, thymoma, lipoma, or even a bronchogenic cyst.

Pulmonary involvement is usually in the form of an interstitial infiltration, which may be mistaken for a radiation effect. With progression, the picture may resemble tuberculosis very closely. The absence of calcification, however, should arouse suspicion of the true nature of the lesion. In later stages consolidation and collapse occur, frequently complicated by cavitation. Planigrams show these cavities to be irregular, unlike the cavities of tuberculosis. In the rare instances in which the Hodgkin's cavity was smooth, the wall was unusually thick.

Miliary Hodgkin's disease is rare and is indistinguishable from sarcoidosis. The presence of enlarged nodes helps to differentiate these two conditions from lymphangitic carcinoma.

Bone involvement is usually late and may be osteolytic, osteoblastic, or a combination of the two. Lesions of the gastrointestinal tract are usually gross and occur late in the course of the disease. Often they cannot be differentiated radiologically from carcinoma.

The author feels that what are regarded as unusual manifestations of Hodgkin's disease are really comparatively common and should be sought in every case.

Eight roentgenograms. J. F. WEIGEN, M.D.
Palo Alto, Calif.

The Pulmonary Manifestations of Generalised Scleroderma (Progressive Systemic Sclerosis). Lionel H. Opie. Dis. of Chest 28: 665-680, December 1955. (University of Cape Town, Cape Town, South Africa)

Connective-tissue alterations are an integral part of generalized scleroderma, which is a collagen disease better described by the term "progressive systemic sclerosis." The author discusses the pulmonary manifestations of the condition. His material consists of 12 consecutive cases of systemic sclerosis seen at the Groote Schuur Hospital in Cape Town. The disease may involve the pleura, the bronchopulmonary tree, and the pulmonary vascular bed, but pleural involvement is uncommon, in contrast to the findings in other collagen diseases.

Pulmonary sclerosis due to systemic sclerosis is a specific process, characterized by diffuse involvement of the interstitial connective tissue. Lysis of alveolar walls with cystic lesions may also occur. The roentgen appearance of the condition is not specific and can be simulated by many other diseases. External evidence of scleroderma, such as Raynaud's phenomenon, scleroderma of the skin, calcinosis, sclerodactyly, and ulcerations can help in the interpretation of the chest film.

Spill-over from the involved esophagus is a cause of pulmonary infections which frequently lead to death in these patients. In 3 out of the 5 fatal cases in this series there was terminal secondary infection.

Pulmonary hypertension is believed to be a much more common complication of scleroderma than previous reports would indicate. In a collected series of 18 cases, including 2 of his own, the author found it to be definitely present in 3 and probably (or possibly) in 12. It is due to anoxia secondary to fibrosis or to obstruction caused by sclerodermatous endarteritis.

Eight figures, including 1 roentgenogram; 2 tables.

ALEXANDER R. MARGULIS, M.D.
University of Minnesota

Intrathoracic Goitre. E. Hoffman. Brit. J. Surg. 43: 310-314, November 1955. (Newcastle upon Tyne, England)

The author reports the symptoms, clinical findings, and surgical considerations in a series of 32 cases of intrathoracic goiter operated on in the years 1942-1954. Four of the goiters were malignant.

The majority of patients had symptoms due to superior mediastinal obstruction from pressure on the trachea, esophagus, vessels, and nerves. Dyspnea was the commonest disability, being present in 18 patients. Pressure on the large venous trunks, with interference to venous return from the head and neck, was found in 13 cases, as shown by headaches, dizziness, and variable degrees of choking sensation. Hoarseness was present in 6 patients, of whom only 1 had a malignant goiter. Eight patients complained of dysphagia, 4 of whom had esophageal displacement shown by the barium swallow examination. In 5 cases there were symptoms of thyrotoxicosis, mild in 3 and moderately severe in 2. This, the author thinks, is in keeping with most previously reported series, in which thyrotoxicosis was not commonly found in intrathoracic goiter. Seven cases were asymptomatic or with unrelated symptomatology.

Clinically, 17 patients had a goiter in the neck; 15 had no thyroid enlargement in the neck, but in 7 of these, a mass could be felt on swallowing, arising from the superior mediastinum. Dilatation of the veins of the chest wall was evident in 9 cases; 6 showed distension of the neck veins only.

Radiologically, the typical broad pyramidal density in the superior mediastinum was seen in most cases, with its base above and apex below. Tracheal displacement was observed in all but 1 case. Esophageal displacement, demonstrable by barium swallow, was present in 14 cases. Unilateral diaphragmatic paralysis was detected in 4 patients, all of whom were found to have benign goiters. This paralysis is presumably due to stretching of the phrenic nerve.

Mediastinal goiters have usually been described as anterior in location. Only 12 cases in this series were entirely anterior. The rest extended to the posterior

mediastinum to a variable degree. Most of these were on the left side. This is in accord with the observation that tracheal and esophageal displacement occur earlier on the left because of anatomical differences.

The 4 patients who were proved to have carcinoma did not differ symptomatically from those with benign goiter. One showed myxedema and another gave a history of previous thyroidectomy. On examination, however, such signs of malignancy as fixation to the neck muscles and tracheal rigidity were present.

Differential diagnosis should include lesions of the lungs, great vessels, esophagus, and thymus. These are often radiologically indistinguishable. The presence of cervical thyroid enlargement or the history of previous thyroid enlargement should be suggestive of a mediastinal goiter. The typical roentgenologic features are displacement and compression of the trachea and movement of the mass on swallowing. Body-section radiography, barium studies, and laryngoscopy are necessary for proper evaluation. At times, angiography may be done.

Surgically, the author suggests a cervical incision with a sternal split as the approach of choice even for posteriorly located goiters. He believes that thoracotomy should be reserved for cases where the mass is low in the thorax or the diagnosis is uncertain.

Thirteen roentgenograms.

HILTON RODRIGUEZ DELGADO, M.D.
Mercy Hospital, Pittsburgh

THE CARDIOVASCULAR SYSTEM

Roentgenologic Evaluation of Cardiac Displacement and Hypertrophy. Nicola De Serio. *Arch. di radiol.* 30: 367-385, Fase. II, 1955. (In Italian) (Istituto di Radiologia e Terapia Fisica della Università di Bari, Bari, Italy)

The author describes an interesting attempt to correlate radiogoniometric changes of the heart shadow (measured on a routine frontal chest teleroentgenogram or preferably on an orthocardiogram) with clinical findings.

First, four points are inscribed on the heart border: *O*, the upper limit of the right atrium; *C*, the lower limit of the right atrium; *V*, the upper limit of the left ventricle; *P*, the apex of the heart. The reference point *G* (jugular, i.e., interclavicular) is in the mid-line, so that a line *G-M* represents the body's midplane. Perpendicular lines drawn from the first four points will reach this mid-line at points designated *O'*, *C'*, *V'*, and *P'*, respectively.

In the average individual, provided the heart is neither enlarged nor displaced, on the orthocardiogram (or on the teleroentgenogram when exposed so that the clavicle angulates medially with the posterior segment of the fourth rib on either side) the point *G* projects over the upper half of the body of T-4. In this case, *O* corresponds to the intervertebral space T-7 to T-8 (3-3.5 cm. to the right of the mid-line), *C* is at the level of T-10 (3.5-4 cm. to the right of the mid-line), *V* is at the height of T-8 (5-5.5 cm. to the left of the mid-line), and *P* is on a parallel plane with the intervertebral space T-10 to T-11 (8-8.5 cm. to the left of the mid-line).

These points may have a slightly different location, determined by the individual body build, but the angles are said to remain comparable except in the presence of spinal and/or thoracic deformities.

A table is included giving average figures for the various angles, and some pathologic correlations.

Eight roentgenograms; 1 table.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

The Value of the Recumbent Oesophagram in Assessing Left Auricular Enlargement. Josse Kaye, B. van Lingen, M. J. Meyer, and M. Zinober. *Brit. J. Radiol.* 28: 693-697, December 1955. (Johannesburg General Hospital, Johannesburg, South Africa)

Roentgenograms of the heart were made on 50 normal patients and 50 with mitral valve disease in the Cardiac Clinic of the Johannesburg General Hospital. The amount of displacement of the barium-filled esophagus by the left auricle was measured in the right anterior oblique position on teleroadiograms taken upright at a 64 in. distance and recumbent at a 72 in. distance.

The posterior displacement of the esophagus was greater in the recumbent view than in the erect view in both normal subjects and patients with mitral valve disease. Using the arbitrary but generally accepted criterion of 14 mm. for the upper limit of posterior displacement of the esophagus in normal subjects, 10 to 12 per cent of the normal cases fell into the abnormal category on the erect view, and 56 per cent on the recumbent view. The authors therefore suggest keeping 14 mm. as the upper limit of normal for the erect view but allowing 23 mm. in the recumbent view.

Since a significant number of normal subjects were found to have posterior displacement of the barium-filled esophagus in the erect view, the authors believe that such displacement, taken as a single finding, is not as reliable as when it is combined with other signs, viz., (a) a left auricular appendage in the postero-anterior radiograph, (b) a double density, best seen in the slightly over-penetrated postero-anterior view, and (c) posterior and upward displacement of the upper cardiac border into the infrabronchial space, in the left anterior oblique view. In their study, no normal subject showed more than two of the four signs, and only 6 of the 50 with mitral valve disease presented less than two of the signs.

Six roentgenograms; 3 drawings; 2 charts; 1 table.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Roentgen Aspects of Atrial Septal Defect, Ostium Secundum. Willis F. Kraemer, Goffredo Gensini, S. Gilbert Blount, Jr., and Raymond R. Lanier. *Acta radiol.* 44: 441-450, December 1955. (Department of Radiology, University of Colorado Medical Center, Denver 20, Colo.)

The authors review their experience in 20 patients with atrial septal defects of the secundum type which were repaired surgically.

This type of defect is located above the embryologic os primum, in the region of foramen ovale. A part of the septum primum exists on the floor of the atrium above the level of the atrioventricular valves, which are uninvolved. This is in contrast to the primum type, in which the atrioventricular valves form the floor of the defect and there is no septum between the defect and the valves.

This anomaly is believed to be the most common congenital malformation of the heart. It represented over 95 per cent of the total cases of atrial septal defect in the authors' experience.

The most constant signs of this anomaly appear to be: (1) increased vascularity of the lungs, (2) enlargement of the main pulmonary artery and its branches, (3) enlargement of the right atrium, (4) associated normalcy of the left heart, and (5) normal or decreased size of the thoracic aorta. These radiographic observations were compared with the surgical, clinical and laboratory findings. No correlation was noted between the vascularity of the lung, age, heart size, main pulmonary artery size, pressure, or pulsations, pulmonic index, or size of the defect. No quantitative significance could be attached to any of the findings.

Other congenital cardiac anomalies may present a similar radiographic and clinical picture. Primum type defects frequently show some degree of left ventricular enlargement, although clinical findings, electrocardiography, cardiac catheterization and blood flow studies with various contrast media may suggest the diagnosis. Large interventricular defects may be differentiated by catheterization. Anomalous pulmonary veins returning to the right atrium are often undetectable by catheterization but may be identified by angiocardiography.

Nine roentgenograms; 1 photograph; 2 tables.

J. F. MARTIN, M.D.
Bowman Gray School of Medicine

Clinical Observations Before and After Mitral Valvoplasty: Physical, Radiologic and Electrocardiographic Changes. John F. Otto, Jr., J. Morrison Hutchinson, Jr., Walter H. Abelmann, Dwight E. Harken, John E. Gary, and Laurence B. Ellis. New England J. Med. 253: 995-1005, Dec. 8, 1955. (Harvard Medical School, Boston, Mass.)

This report is based upon 106 consecutive patients who survived operation for predominant mitral stenosis, and were followed from twelve to fifty-six months postoperatively. The follow-up study included an interval history, a physical examination, cardiac fluoroscopy, and electrocardiography.

There was significant clinical improvement in 77 per cent as judged by a feeling of well-being, nutrition, ability to work, and such criteria as fatigue, orthopnea, paroxysmal dyspnea, pulmonary edema, hemoptysis, palpitation, arrhythmia, and edema. After initial improvement, a few patients experienced regression within two years after operation, but this usually appeared to be related to other factors than active rheumatic carditis.

Postoperatively, there was a significant rise in systolic blood pressure and of the pulse pressure. There was a tendency for the mitral diastolic murmurs to become less intense, but they disappeared in only 10 per cent of the series. Changes in apical systolic murmurs were unpredictable. The net result was more frequent and louder systolic murmurs, although some disappeared. A high-pitched blowing parasternal diastolic murmur, sometimes heard along the left sternal body, decreased or disappeared in about half the cases. It seemed to be functional.

The importance of accentuation of the first mitral sound in distinguishing stenosis from regurgitation was established. Postoperatively, this accentuation was gradually reduced in half the cases; this was more likely to occur with marked clinical improvement. Accentuation of the second pulmonic sound is an important but not completely reliable guide to the degree of pulmonary hypertension. It diminished after opera-

tion in a third of those in whom it had previously been observed, with a return to normal in 17 per cent.

Teleroentgenographic cardiac measurements indicated no difference in the average overall heart size before and after operation. Individually, there was noted decrease in size of the main pulmonary artery, peripheral pulmonary vessels, and right ventricle, in varying degree, but the majority of the cases showed no change in these respects, and some showed what appeared to be an increase in size. In general, x-ray improvement paralleled functional improvement and, therefore, may be significant from the point of view of prognosis.

Systolic expansion of the left auricle on fluoroscopy as a sign of mitral regurgitation was not confirmed at operation. Preoperative diagnosis of calcification of the mitral valves was established surgically in all cases with heavy calcification.

Electrocardiography proved to be of considerable prognostic aid in cases where hypertrophy of the right ventricle was present. Such findings are correlated with the degree of pulmonary hypertension and pulmonary resistance, which is a function of pulmonary arteriolar resistance and obstruction by the stenotic mitral valve. Clinical improvement is accompanied by gradual reversion of right axis deviation. The "P pulmonale" waves often became smaller as dilatation of the right atrium diminished and the pulmonary hypertension dropped. Electrocardiographic evidence of hypertrophy of the left ventricle may be of prognostic aid, since only 1 out of 8 patients received marked symptomatic benefit from surgery.

One graph; 11 tables. WILLIAM SNOW, M.D.
Shreveport, La.

Angiocardiography: Its Development, Technic, and Findings, and Role in Surgical Heart Disease. Arthur David Fisher. Dis. of Chest 28: 651-664, December 1955. (Mt. Sinai Hospital and Clinic, Los Angeles, Calif.)

This is a general discussion of angiocardiography presented before the American College of Chest Physicians. The author reviews the history from 1931, when Moniz, Carvalho, and Lima made the first satisfactory studies with the use of catheters. After describing conventional technics of serial filming and injection, he suggests the importance of amplification and cineradiography for the future development of the procedure.

Angiocardiography is said, in summary, to have "its greatest value in the diagnosis of congenital heart anomalies. It is helpful in the delineation of the defects present and, with cardiac catheterization, supplements the conventional methods of examination. It is applicable to a considerable number of the problems seen in practice, and to most of the cases coming to surgical correction. It has contributed greatly to understanding of these problems and it has improved and modified our conventional methods of study by the knowledge gained through its use."

"Its application to acquired heart disease is somewhat more limited and it finds its greatest usefulness in problems which resist solution by conventional means and in which its particular ability to delineate certain structures is of great value, such as aneurysm, aortic disease, pericardial disease, and occult heart failure. It is also valuable in evaluating mitral valve disease."

Angiocardiography should not be used exclusively of other procedures, but should supplement conventional

radiography, fluoroscopy, and occasionally even planigraphy.

ALEXANDER R. MARGULIS, M.D.
University of Minnesota

Thoracic Aortography. John W. Pender, John W. Kirklin, and George D. Davis. *J.A.M.A.* **159:** 1738-1739, Dec. 31, 1955. (Mayo Clinic, Rochester, Minn.)

The authors have used thoracic aortography to visualize suspected lesions in the lower thoracic and upper abdominal aorta. During the course of a year they carried out this procedure in 6 patients. Details as to the technic are described.

In the 6 cases there were found 2 aneurysms of the thoracic aorta associated with fusiform dilatation of the abdominal aorta, an aneurysm of the hepatic artery, an arteriovenous fistula between the right renal artery and vein, and 2 normal aortas for which abdominal exploration had been contemplated on the clinical impression of upper abdominal aneurysm.

Despite the fact that there were no complications in the cases studied and that valuable information was obtained, it is recommended that the procedure be reserved for special diagnostic problems.

One roentgenogram. SAUL SCHEFF, M.D.
Boston, Mass.

Retrograde Aortography in the Diagnosis of Congenital Heart Disease in Infants. Edward B. Singleton, Dan G. McNamara, and Denton A. Cooley. *J. Pediat.* **47:** 720-726, December 1955. (E. B. S., 6621 Fannin St., Houston 25, Texas)

The diagnosis of congenital heart disease in infancy is frequently difficult. Great reliance cannot be placed on physical findings, and the abnormality has not been present for a sufficient length of time to produce the characteristic radiographic configuration of the heart seen in older patients. Although cardiac catheterization and angiography are extremely useful in diagnosis of most congenital abnormalities of the heart, they may be inadequate in demonstrating the exact nature of extracardiac shunts and in detecting abnormalities of the aortic arch.

By the retrograde injection of radiopaque material into the left brachial or radial artery, abnormalities of the thoracic aorta or of communications between the aorta and pulmonary artery can be demonstrated. This procedure has been useful in establishing or excluding the diagnosis of patent ductus arteriosus, aortic septal defect, coarctation of the aorta, and true truncus arteriosus.

The differential diagnosis in infancy between a high ventricular septal defect and a large patent ductus arteriosus in which the continuous murmur has not developed is frequently difficult. Retrograde aortography will demonstrate a communication between the aorta and pulmonary circulation in patent ductus arteriosus, while in ventricular septal defects no such communication is shown. Occasionally the aortic-pulmonary shunt is produced by an aortic septal defect and the aortographic findings may be indistinguishable from those in patent ductus.

In true truncus arteriosus large pulmonary arteries arise from the aorta, usually from the ascending portion. Adequate filling of the ascending aorta by retrograde aortography will result in visualization of the contrast material in the pulmonary circulation. Differentiation from patent ductus arteriosus or aortic pulmonary septal defect may be made by angiography.

Retrograde aortography demonstrates the site of coarctation of the aorta accurately, and if patent ductus arteriosus is also present, opacification of the pulmonary arteries will be evident.

Illustrative cases in which this procedure has proved to be of value are presented.

Ten roentgenograms.

HOWARD L. STEINBACH, M.D.
University of California, S.F.

A New Technique for Thoracic Aortography Using the Right Supraclavicular Approach. B. Eiseman and W. G. Rainer. *Arch. Surg.* **71:** 859-862, December 1955. (University of Colorado School of Medicine, Denver, Colo.)

The need for roentgen aortography at the thoracic level has been stimulated by recent development of vascular surgery which has made many formerly hopeless lesions amenable to correction. Since retrograde aortography by way of the carotid, radial, or femoral artery is not entirely satisfactory, the authors have devised a modification of the percutaneous cervical approach recently described by Wickbom, whereby, the needle is inserted parallel to the right carotid artery into the arch of the aorta (*Acta radiol.* **38:** 343, 1952. *Abst. in Radiology* **61:** 448, 1953). Though Wickbom reported a fatality when the contrast substance was inadvertently directed into the ascending aorta so as to perfuse the coronaries, the authors carried out the procedure without difficulty or mishap in 4 cases. The patients experienced only momentary discomfort when the needle was passing through the wall of the aorta.

The patient is placed in the dorsal decubitus position with the head turned to the left. A number 17 short-beveled 15.4 cm. aortogram needle fitted with a stylet is inserted in the right midclavicular line, 1 cm. above the clavicle, following anesthetization of the skin with Novocain. The needle is directed medially, inferiorly, and slightly posteriorly to a point 3 cm. below the jugular notch in the midsternal line. This indicates the high point of the aortic arch at which the needle should make contact with the aorta. When this is done, a transmitted pulsation will be clearly felt. The needle is then advanced another 0.5 to 1.0 cm., at which time the stylet is removed, allowing pulsatile ejection of blood. In this manner the needle is directed away from the ascending and into the descending arch.

Thirty ml. of 70 per cent acetrizoate (Urokon) is injected rapidly, and film exposure is begun just at the end of the injection.

Four roentgenograms; 2 drawings.

WILLIAM SNOW, M.D.
Shreveport, La.

Demonstration of Collateral Circulation During Acute Obstructions of the Thoracic Aorta. Steven M. Horvath, Enid Allbaugh, and L. Hamilton. *Am. J. Physiol.* **183:** 193-196, November 1955. (State University of Iowa, College of Medicine, Iowa City, Iowa)

Previous studies of splanchnic blood flow during obstruction of the thoracic aorta suggested the presence of collateral pathways from the thoracic to the abdominal aorta (Allbaugh and Horvath. *Am. J. Physiol.* **180:** 451, 1955). In the present investigation, both collateral circulation and the rapidity of exchange of blood between the two vascular beds were demonstrated in 17 experiments upon 14 mongrel dogs.

The aorta was occluded by inflation of a balloon

positioned at the fourth thoracic interspace. Blood and plasma volume determinations with radioactive iodinated serum albumin were made at intervals before and after release of the occlusion. Demonstration of the anastomotic collateral circulation was by two procedures. In the first, roentgenography followed injection of 20 ml. of 35 per cent Diodrast into the thoracic aorta above the obstructing balloon. In the second, a section of the back of the animal was removed, keeping the aorta and all its branches intact. After clamping, an injection of vinyl acetate made radiopaque with vermillion water color was administered. Dissection and roentgenography of this preparation were then performed.

Collateral circulation was shown to be mainly by way of the anterior spinal arteries, becoming established within a few seconds following obstruction of the aorta. A small quantity of blood was found to be trapped in the lower segment of the body.

Two roentgenograms; 1 table.

Use of the Image Amplifier in Cardiovascular Diagnosis. Henry A. Zimmerman. *J.A.M.A.* 159: 1449-1451, Dec. 10, 1955. (250 Hanna Bldg., Cleveland 15, Ohio)

The image amplifier is essentially a high vacuum tube which has, just within its wall, a fluorescent screen backed by a photoelectric surface. The light produced on the screen by x-rays is converted to electrons by the photoelectric surface and these are accelerated by a high potential through a system of lenses to an aluminum-backed phosphor layer where they are condensed into a smaller area. The resulting image produced on the output phosphor is 200 times brighter than that on the original fluoroscopic screen.

The author's one objection to the tube is that the screen diameter is fixed at 5 inches at all times. This is outweighed, however, by such advantages as the decreased irradiation to patient and personnel, since there is good visualization at only 70 kv with 2 ma; the possibility of taking motion pictures at 36 or 72 frames per second at the viewing mirror in contrast to the 2 to 8 frames per second obtainable with an automatic cassette changer; the adequacy of cone vision for visualization of the intensified image, so that the patient may be kept in a lighted room, thus diminishing his apprehension.

Of particular importance in cardiovascular diagnosis is the fact that the tip of the catheter is seen in a three-dimensional fashion at all times during cardiac catheterization, whereas in conventional fluoroscopy it is usually lost from view in large hearts, especially when crossing the vertebral bodies. Other advantages are the ability to visualize the extent and magnitude of pulmonary blood flow, easier detection of aortic and mitral valve calcification, and the clear demonstration of intrinsic and extrinsic pulsations in pulmonary masses or nodules, differentiating them from vascular lesions.

One photograph; 2 drawings. SAUL SCHEFF, M.D.
Boston, Mass.

Intra-osseous Venography in Skeletal and Soft Tissue Abnormalities. Franz P. Lessmann, Robert Schobinger von Schowingen, and Elliott C. Lasser. *Acta radiol.* 44: 397-409, November 1955.

The authors report their clinical experience with intra-osseous venography in investigating (1) involvement of the azygos and hemi-azygos veins in chest and

mediastinal diseases, (2) studying the vertebral plexus in normal and pathological circumstances, and (3) in determining the feasibility of detecting isolated neoplastic bony involvement.

Previous investigators observed that bone marrow injections of contrast media produced no pathologic reactions and allowed visualization of the vertebral, azygos, cranial, intercostal, and mediastinal venous systems. The anatomy of the azygos system as well as the vertebral system of veins is reviewed in detail.

The procedure utilizes a size 17 bone-marrow needle and three syringes of 2 ml., 10 ml., and 20 ml. capacity. After sedation with Seconal and Demerol, local anesthesia of the selected site is carried out with 1 per cent Procaine and the needle is introduced into the medullary cavity. A small amount of marrow tissue is aspirated, and 1 or 2 ml. of 70 per cent Urokon is injected as a test dose. Following this, up to 20 c.c. of the medium is injected and serial radiographs are obtained with either a manual or automatic cassette changer. Over 80 injections have been carried out without untoward incident. Twenty-five postmortem injections were made, and some studies of normal anatomy were done in healthy persons.

Five complete blocks of the internal vertebral plexus due to metastatic neoplasm were demonstrated by injection into spinous processes. In 4 cases of traumatic lesions of the vertebrae and disk degenerations the venograms were normal.

Of 10 studies of the azygos, 5 revealed complete block due to bronchogenic carcinomas of the right upper lobe. Two of these showed recanalization of the azygos vein after irradiation. Two cases of bronchial cancer of the left upper lobe showed normal filling of azygos and hemi-azygos. Seven thoracic-cage studies in patients with osteolytic lesions in the posterior ribs showed displacement and narrowing of the adjacent intercostal vein. Two instances of osteoblastic rib lesions showed no intercostal vein abnormalities. Complete obstruction of the hypogastric veins with collateral circulation was observed in the presence of pelvic tumors, following injection of media into both iliac bones.

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Sacrolumbar Venography. C. G. Helander and Å. Lindblom. *Acta radiol.* 44: 410-416, November 1955. (Roentgen-diagnostic Department, Karolinska Sjukhuset, Stockholm, Sweden)

Following local anesthesia, polyethylene catheters were introduced into the femoral veins on both sides according to Seldinger's percutaneous method (*Acta radiol.* 39: 368, 1953. *Abst. in Radiology* 62: 466, 1954). The tip of the catheter was placed 10 cm. cranial to the site of puncture in the iliac vein. This corresponds to the confluence of the external and internal iliac veins. Catheterization is safer than direct needling and allows injection close to the internal iliacs. The inferior vena cava was blocked with a football bladder pressed against the abdomen with a plastic plate. Thirty milliliters of 35 per cent Umradiil is injected simultaneously into both tubes and 3 or 4 supine serial radiographs are made at intervals of two to four seconds, with a simple manual cassette changer.

Seventy-five patients, chiefly women twenty to sixty years of age with uterine cancer, were examined without complications. The lumbar veins appeared similar in women with and without tumor, as well as in men.

When the inferior vena cava was obstructed, the vertebral veins transported the blood to the azygos and hemi-azygos system. With rapid injection, there was free passage of the medium in a retrograde direction into the presacral vessels, from which it passed into the veins of the vertebral canal.

In 3 patients with lumbar disk herniations, the venous plexus behind the herniated disk was not contrast-filled. Two patients with Hodgkin's disease with destruction of the 3rd and 4th lumbar vertebrae showed failure of filling of the vertebral veins overlying the involved areas.

In some cases, partial filling of the vertebral veins was seen when no compression of the vena cava was applied, but the patient was straining heavily (Valsalva). Epidural varices may also be demonstrated by this method.

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THE DIGESTIVE SYSTEM

Regurgitant Esophageal Ulcer. Herbert W. Schmidt. Arch. Int. Med. 96: 717-723, December 1955. (200 1st St., S.W., Rochester, Minn.)

The author calls attention to the lesion known as regurgitant or peptic esophageal ulcer. Most of these lesions are secondary to esophageal hiatal hernia of the sliding type or to operations on the cardia. The esophagus becomes short and usually constricted as a result of fibrosis in the muscular layers, caused in turn by chronic esophagitis.

The commonest symptoms of regurgitant ulceration of the esophagus are dysphagia, retrosternal burning, epigastric pain, pyrosis, vomiting, and hemorrhage. Roentgenologically, the esophagus is seen to be shortened and may appear slightly dilated. The esophago-gastric junction may be anywhere from just above the diaphragm to as high as the level of the aortic arch. The constriction, if pronounced, will extend 1.5 to 2 cm. in length. If the lesion is the result of persistent prolonged vomiting, a diffuse fusiform stricture involving the distal half or more of the esophagus may be seen. The gastric folds can be visualized extending through the diaphragmatic hiatus into the thorax. The intrathoracic portion of the stomach may be narrowed in such a way that it appears to be part of the esophagus below a stricture. If the patient is examined in the Trendelenburg position, reflux from the stomach can be demonstrated. When minimal changes are present, the roentgenologist may call the esophagus and stomach "normal." If symptoms or roentgen findings suggest regurgitant ulceration at the esophagogastric junction, esophagoscopy should always be performed to identify the lesion and to rule out carcinoma.

Any state which will allow acid gastric or alkaline duodenal secretions to come into prolonged contact with esophageal mucous membrane may produce this type of ulcer. It is therefore important in patients vomiting for any reason whatever to eliminate the cause. Operations on the cardia which involve incision into all layers of the esophagus are followed by the development of esophageal ulcers in high percentage of cases, and such surgical procedures are condemned.

After a regurgitant ulcer has formed, no treatment known at present is altogether satisfactory. Surgery should be resorted to only when conservative measures have failed and symptoms are severe.

Five roentgenograms; 3 drawings.

Oesophageal "Spasm" in Infancy. Roy Astley. Proc. Roy. Soc. Med. 48: 1045-1049, December 1955. (The Children's Hospital, Birmingham, England)

Five illustrative cases of temporary and presumably spastic obstruction in the lower portion of the infant's esophagus are presented. The author has seen complete obstruction only in the first few weeks of life. In these cases there is a complete hold-up of the barium meal just above the diaphragm. After a few minutes the obstruction may be relieved completely or partially. More often, the obstruction is partial from the beginning, with the obstructive level at the same site, 1 to 2 cm. above the diaphragm; below this the barium passes intermittently and the lumen may be irregularly narrowed.

Temporary esophageal obstruction just above the diaphragm in the infant usually proves to be associated with gastroesophageal incompetence and a small loculus of thoracic stomach. The author suggests that so-called cardiospasm in early infancy, with the exception of the postoperative type, is usually a temporary obstruction at the intrathoracic gastroesophageal junction and is not identical with the adult condition.

Nine roentgenograms. J. F. WEIGEN, M.D.
Palo Alto, Calif.

Inflammatory Lesions of the Esophagus and Stomach. Fred J. Hodges and Philip Rubin. Am. J. Roentgenol. 74: 989-999, December 1955. (F. J. H., University Hospital, Ann Arbor, Mich.)

Esophagitis was detected in only 93 and chronic hypertrophic gastritis in only 101 of 21,008 roentgenologic examinations of the upper digestive tract over a period of five years. Diminution of the lumen was the most arresting finding in the esophagus, with irregularity of contour, ulceration, a mass, and perforation being recorded in some cases. Three-fourths of these lesions were in the lower third of the esophagus. Esophagitis with shortening occurred more commonly with sliding hiatal hernias. Peptic ulcer of the esophagus was less reliably demonstrated by roentgen than by endoscopic examination.

Visible narrowing of the esophageal lumen of varying length also was seen following ingestion of exorciating substances, in association with the Plummer-Vinson syndrome, congenital bands, varices, cardiospasm, pemphigus, and scleroderma, and after heavy doses of irradiation or prolonged intubation.

Exclusive of peptic ulcer, inflammatory lesions of the stomach detected roentgenographically consist chiefly of hypertrophic gastritis of diffuse or segmental variety. The latter is chiefly found in the gastric antrum. The mucosal folds are high, broad, and tortuous, and cannot be eradicated by normal palpation. There is irregular narrowing of the lumen without rigidity.

The non-specific regional inflammatory lesions encountered in the small bowel and colon, such as Crohn's disease, as well as specific tuberculosis or syphilitic lesions, are rarely found in the stomach.

Thirty-one roentgenograms.

J. A. CAMPBELL, M.D.
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Clinical Picture of Pyloric Channel Ulcer. Analysis of One Hundred Consecutive Cases. Julian M. Ruffin, David H. Johnston, Donald D. Carter, and George J. Baylin. J.A.M.A. 159: 668-671, Oct. 15, 1955. (Duke University School of Medicine, Durham, N.C.)

Channel ulcer, one of the severer forms of benign

peptic ulcer, occurs in or near that portion of the stomach lying between the antrum and duodenum (about 1.0 cm. in length). Of 825 peptic ulcers seen at Duke Hospital in 1953, 4.3 per cent were of this type. The present paper is based upon 100 consecutive cases proved radiologically or at operation and comparison is made with 100 radiologically proved cases of uncomplicated duodenal ulcer.

The symptoms, which constitute a characteristic syndrome, are nausea, vomiting, upper abdominal pain, and marked weight loss. Nausea with vomiting (usually of small amounts) was present in 83 of the 100 cases studied and was often nocturnal and episodic, occurring before, immediately after, or without relationship to meals. Seventy-nine patients complained of pain which, as a rule, was totally different from the usual ulcer pain in that it was colicky, unrelated to meals, and unrelieved or even aggravated by food; in many cases the pain was constant and severe. Fifty-four patients had lost more than 15 pounds in weight.

An incorrect diagnosis was made in over half of the cases, psychic vomiting and gastric carcinoma being the most common misdiagnoses.

Channel ulcer suspected clinically should be confirmed by the following radiological signs: lengthening and distortion of the pyloric sphincter, a niche in the enlarged canal, some gastric retention. The last is sometimes the only radiologic abnormality.

Three case reports are included.

One roentgenogram; 3 photographs and photomicrographs; 1 diagram; 2 tables.

IAN B. D. MIDDLEMASS, M.D.
University of Michigan

Pyloric Hypertrophy in the Adult. V. F. Marx. Československá roentgenol. 9: 171-176, September 1955. (In Czech)

Hypertrophy of the pylorus is not uncommon in infants but is rarely seen in adults. Short of direct inspection (surgery or autopsy), the diagnosis is based on roentgenologic findings, which include a defect in the base of the duodenal bulb, resembling prolapsed mucosa, and especially a rigid and elongated pyloric canal, metaphorically termed "glovefinger." Originally, the condition is probably caused by a neurovegetative reflex, while long-standing (chronic) pylorospasm results in hypertrophy of the antral musculature, which is the organic substratum of the disease. The author contributes 2 histologically proved cases.

Eight roentgenograms. G. I. PAPRIKOFF, M.D.
Cook County Hospital, Chicago

Lymphosarcoma of the Stomach. A. J. Richards. J. Canad. A. Radiologists 6: 60-64, December 1955. (1809 Rose St., Regina, Sask.)

Lymphosarcoma of the stomach has a much better prognosis in general than a carcinoma of the same size and location. Four of the author's 13 patients were living and well from one to five years postoperatively.

Of a total of 576 cases of lymphosarcoma of all types, 42 were found to involve the stomach. In 29 the stomach involvement was part of a generalized process while in 13 it was primary. The abnormal x-ray findings followed the usual pattern: large filling defect or extensive infiltration out of proportion to the general condition of the patient; grossly enlarged rugal folds, often still pliable and showing peristalsis; ulcer deep and large when present.

In the statistical analysis the author found that his 42 cases constituted only 2.3 per cent of all malignant tumors of stomach seen in the same period of time, with the 13 primary cases representing only 0.75 per cent. Considering the cases of lymphosarcoma of the stomach alone, there was a rise in the incidence curve in the third decade, although not in a curve for all types of lymphosarcoma.

Four roentgenograms; 3 graphs.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

The Effect of Exclusion of the Bile upon Gastrointestinal Motility. Rosalind Shapiro Thorner. Am. J. Roentgenol. 74: 1096-1122, December 1955. (Department of Radiology, Hospital of the University of Pennsylvania, Philadelphia, Penna.)

In experiments on dogs, exclusion of bile from the intestine was found by the author to delay gastrointestinal motility, while restoration of the bile stream to the intestinal lumen caused a return to normal. Bile acids, especially glycocholic acid, introduced into the intestine exerted a similar favorable effect on motility. The mode of action of the bile acids is not definitely known. The gastrointestinal tract showed no typical appearance or pattern during the period of bile exclusion.

In studies of patients who were probably partially acholic, a suggestive, if not pathognomonic, picture of the bile-poor gastrointestinal tract was obtained. The stomach empties slowly and the small intestine is dilated, showing pockets of gas, with a coarse, flattened mucosal relief particularly in the upper jejunum. There is abundant evidence of peristaltic contractions in the small intestine, yet the meal proceeds so slowly as to give rise to the suspicion of intestinal obstruction.

The author concludes that the significant findings in the bile-poor gastrointestinal tract are a delayed gastric emptying and a marked delay in the small intestinal passage time. Changes occur in the small intestinal pattern but are not pathognomonic of the absence of bile from the gastrointestinal tract.

Twenty-five roentgenograms; 6 charts; 11 tables.
THEODORE E. KEATS, M.D.
University of Missouri

Influence of Right Phrenic Exeresis on Gastric and Biliary Mechanisms. N. C. Jefferson, L. Walker, and H. Necheles. Am. J. Physiol. 183: 237-239, November 1955. (Medical Research Institute, Michael Reese Hospital, Chicago, Ill.)

Previous studies have demonstrated that exeresis of the left phrenic nerve is followed by a considerable reduction of gastric emptying time in both dog and man. In order to analyze further the effects of the phrenic nerve on gastrointestinal mechanisms, right phrenicotomy was performed in the dog, and the function of the stomach and gallbladder was studied pre- and postoperatively. For determination of gastric emptying times, the animals were fed a standard barium meal, with fluoroscopy at intervals until the stomach was empty. Roentgenograms were taken for disclosure of changes in position and function of the stomach and of the duodenal bulb. The position and function of the gallbladder were determined cholecystographically. It was found that, despite elevation of the gallbladder, pylorus, and duodenal bulb, gallbladder and gastric

emptying times were apparently not affected by the exeresis.

Eight roentgenograms.

Roentgen Findings in Regional Enteritis. Richard H. Marshak and Bernard S. Wolf. Am. J. Roentgenol. 74: 1000-1014, December 1955. (R. H. M., 1075 Park Ave., New York 28, N. Y.)

Since the classical form of regional enteritis is a low-grade inflammatory process with episodes of acute exacerbation, it is difficult to identify the precise onset of the disease. What is described as the acute phase may be a more active phase of the chronic disease. The maximum length of the involved area is determined on the initial roentgen studies and does not change unless exclusion operations are done. Extension to the colon is uncommon. Cases may be conveniently divided into stenotic and non-stenotic groups, but they cannot be classified as early and late since many continue without stenosis for years.

The present study is based on 750 patients followed over periods of one to twelve years, affording an opportunity for serial clinical and roentgen investigations.

In the *non-stenotic* phase early roentgen changes are blunting, flattening, thickening, and straightening of the valvulae conniventes. The lumen and contour of the bowel become irregular. When ulceration occurs, longitudinal streaks of barium are recognized, and as mucosa is destroyed, a cobblestone pattern is produced, chiefly in the jejunum. Ulceration spreads but is usually incomplete, leaving behind islands of inflamed mucosa producing multiple smooth defects of varying size. Their prominence is increased by cicatricial narrowing of the bowel lumen. Finally, a uniform, rigid, cast-like tube may be seen, filled with barium and showing no mucosal pattern. Small inflammatory polyps may occur as scarring proceeds into the stenotic phase. Carcinomatous transformation of these polyps was not observed. Coiled patterns change to rigid segments with separation due to indurated mesentery. Skip areas vary from a few inches to several feet in length.

In the *stenotic* stage many of the rigid loops become constricted to resemble pipestems 1 or 2 cm. or more in length. With severe narrowing, dilatation of the proximal intestine may be marked, and the disease may or may not extend into the dilated area. Extreme dilatation over long segments is rarely associated with intrinsic granulomatous disease, however. Fixation of loops occurs in this phase, followed by fistulae in the distal ileum, which may extend to and penetrate the abdominal wall.

Of 750 patients studied, 506 revealed involvement of the distal 9 to 12 inches of the terminal ileum; in 126 the entire ileum was involved. The string sign is most frequently noted in this area in both the non-stenotic and stenotic phases. It does not always indicate fibrosis or stenosis. Obstruction is rare. Although cecal deformity may occur, the disease ends abruptly at the ileocecal valve.

One hundred and two cases of ileojejunitis were found, and large inflammatory polyps were noted in some. Only 12 cases of isolated involvement of the jejunum were seen. All were stenotic, without ulceration or fistula. Four cases involved the duodenum alone, none the stomach.

Recurrent disease following sidetracking surgery is most frequent in the first year and in patients with

marked ulceration and stenosis. The recurrence usually appears in the new terminal ileum. Demonstration of spontaneous healing was rare in this series.

Combined forms of regional enteritis and diffuse ulcerative colitis are uncommon. Regional right-sided colitis of a non-specific ulcerative type was observed in 20 cases with ileal involvement. Four showed stenotic changes. This form is not to be confused with the "back wash" extension of ulcerative colitis into the ileum. The ileal lesion is continuous with the colon in these instances. The lack of fistula, lesser degree of narrowing, without dilatation of the proximal segment, and absence of thickened mesentery or pressure defect on the cecum help to distinguish the changes in non-specific ulcerative enteritis from those of regional enteritis.

Inflammatory disease of the ileum also occurs after ileocolostomy or ileostomy for right-sided ulcerative colitis, even when the terminal ileal segment is normal microscopically at operation.

Twenty-five roentgenograms.

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Indiana University Medical Center

Intestinal Obstruction. Paul C. Hodges and Roscoe E. Miller. Am. J. Roentgenol. 74: 1015-1022, December 1955. (P. C. H., 950 East 59th St., Chicago, Ill.)

When used in conjunction with the history, palpatory and auscultatory findings, roentgenologic inspection is useful in establishing the existence, location, degree, and complications of intestinal obstruction. Employed alone it may be dangerously misleading. The capacity of the jejunum and ileum easily accommodates large amounts of air and fluid without distention in the absence of obstruction.

Strangulation occurs when the blood supply of the bowel is compromised by severe distention, mechanical blockage of the lumen, arterial occlusion, or venous thrombosis. A small bowel segment obstructed at both ends, or "closed loop," with no air in the distended segment resembles a neoplastic mass displacing other abdominal viscera; roentgen diagnosis is easier when the loop contains air and presents the coffee-bean sign.

Grid roentgenograms with the patient supine should never be omitted. In this position gravity flattens the abdomen, and when, in addition, a compression band is applied, there is a significant decrease in the thickness of the tissue to be penetrated, with corresponding reduction in scatter. Any gas-filled loops that are free to move will float to the anterior abdominal wall and any free peritoneal fluid will sink in the flanks. Small amounts of air and fluid may be overlooked unless special films are made with the incident cone of radiation directed tangentially to the interface of fluid and air. This is accomplished by having the patient stand facing the film, lie on his back with the film at his side, or lie on his side with the film against the anterior abdominal wall. Jejunal loops show a "herringbone" pattern and are localized in the upper left abdomen, while ileal loops tend to lie lower and farther to the right, with fewer plicae circulares. In colonic obstruction, the ileocecal valve usually prevents reflux of fluid and gas into the small bowel unless the valve is incompetent because of congenital shortness of the lower lip.

The probability of strangulation is increased when dilated loops of bowel are fixed, painful, and tender. Such is not always the case, however, particularly in

arterial and venous mesenteric vascular occlusions. Such dead segments may not interfere with forward movement of intestinal contents and may appear normal when filled with barium.

Experimental pneumoperitoneum performed by one of the authors (R. E. M.) showed that as little as 1 or 2 c.c. of air was visible in thirty minutes between the liver and diaphragm on stereoscopic chest films with the patient standing facing the films.

Twelve roentgenograms; 1 drawing.

J. A. CAMPBELL, M.D.
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Leiomyosarcoma of the Small Intestine. A Report of Three Cases and Review of the Literature. James F. Martin. *Am. J. Roentgenol.* **74**: 1081-1088, December 1955. (North Carolina Baptist Hospitals, Winston-Salem, N. C.)

Leiomyosarcoma of the intestine is of intramural origin but may be intraluminal or extraluminal in its roentgenologic manifestations. It was first reported by von Salis (*Deutsche Ztschr. f. Chir.* **160**: 180, 1920) and about 30 additional cases have appeared in the literature, including the 3 cited by the author. These lesions have involved the duodenum, jejunum, ileum, and Meckel's diverticulum.

The tumors originate in smooth muscle, are single or multiple, and may present as small or large sessile or pedunculated polypoid masses within the bowel or an extraluminal mass causing extrinsic deformity. Central necrosis, ulceration, fistula and sinus tract formation, perforation, and even abscess formation may complicate the primary condition. Calcification sometimes occurs. Clinical manifestations include hemorrhage into the bowel, varying degrees of obstruction, a palpable mass, and jaundice as a result of pressure on the common bile duct or ampulla of Vater.

Roentgenologically, the intraluminal lesions produce sharply defined filling defects, distortion of the mucosal pattern, and superficial ulceration, features which are common to leiomyoma. The extraluminal variety shows narrowing of the lumen, mucosal distortion, ulceration, aperistaltic areas, and fistulae or sinus tracts between the lumen of the bowel and the central portion of the tumor. The roentgen syndrome of deep ulceration and fistula is characteristic of these tumors, but not pathognomonic, since similar changes have been described in association with leiomyoma, lymphomas, melanomas and inflammatory disease. It is probable that intraluminal projection of the tumor allows it to be more readily detected roentgenographically.

Eight roentgenograms; 1 photograph.

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The Ileo-Cecal Valve in Diseases. S. L. Beranbaum and Kakarla Subbarao. *Am. J. Digest. Dis.* **22**: 331-335, December 1955. (S. L. B., 121 E. 60th St., New York 22, N. Y.)

Involvement of the ileocecal valve by disease is not usually important of itself but may be confusing if not recognized. Early in the course of inflammatory diseases in the ileocecal region (terminal ileitis, enterocolitis, and ulcerative colitis) the valve is swollen and enlarged but later becomes thin and atrophic. Other conditions mentioned are neoplasms, prolapse, and intussusception. The accompanying illustrations show

a lipoma arising very close to or on the ileocecal valve and a case in which the valve was distorted by post-appendectomy adhesions.

Sixteen roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Variable Contrast Barium Enema. A. M. Fraser. *Brit. J. Radiol.* **28**: 698-700, December 1955. (Pontefract and Castleford Group, Pontefract, England)

In examining the colon, the author uses two enemas containing barium suspensions of different strength, connected by a Y-tube. Normal strength barium (one part micropaque to three parts water) is run in from one can until the head of the column reaches the splenic flexure, and films are then taken in whatever positions are desired. Water or dilute barium (about 1 to 20) is then run in from the second enema can, displacing the original mixture around to the right colon. During this procedure the rectum and sigmoid gradually become more transradiant. By the time the cecum and terminal ileum are filled, the rectum and sigmoid are only faintly outlined and provide no interference to the screening or filming of the former.

According to the requirements of a particular case and the progress of the enema, more or less barium suspension may be used from either container. Films made at the conclusion of the two-can procedure are somewhat comparable, as regards definition of the sigmoid colon, to those obtained with ordinary barium and high-voltage technic.

Eleven roentgenograms.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

The Radiologist's Responsibility in Making the Diagnosis of Pancreatitis. Kirk R. Deibert. *South. M. J.* **48**: 1264-1269, December 1955. (R. F. D. 1, Florence, Ala.)

In a radiologic study of 200 cases an attempt was made to distinguish between the causes of upper abdominal pain, with a special view to the diagnosis of pancreatitis. On the basis of a gastrointestinal series, a diagnosis of chronic pancreatitis was made in 17 instances, of acute pancreatitis in 20, and of combined inflammatory change of gallbladder, pancreas, and/or duodenum in 3. These diagnoses were verified by clinical laboratory study, surgery, or autopsy, alone or in combination.

The primary causes of pain to be weighed in the differential diagnosis are peptic ulcer, biliary disease, and pancreatitis. Myocardial infarction, renal colic, appendicitis, ileus or peritonitis, and gallbladder or extrahepatic biliary tract disease should be eliminated by preliminary examination. The relationship to the spine of an altered barium profile of the stomach and duodenum is described as a method of differentiation of pancreatitis from peptic ulcer and biliary disease. Features to be noted in the pertinent radiologic examinations are enumerated.

Four roentgenograms; 2 drawings; 1 table.

Annular Pancreas. David S. Carroll. *South. M. J.* **48**: 1270-1276, December 1955. (John Gaston Hospital, Memphis, Tenn.)

Five cases of congenital annular pancreas in infants, seen within a period of three years, are presented. The roentgen findings, which are of paramount importance in the differential diagnosis, include marked dilatation

of the proximal portion of the duodenum with an abrupt, smooth, concentric narrowing in the descending portion.

Identification of the condition is easiest in such cases as the author's, i.e., in young children with marked but incomplete obstruction. In these instances, pylorospasm, hypertrophic pyloric stenosis, congenital atresia, and incomplete rotation of the colon with congenital obstructing bands must be considered in the differential diagnosis. In adults, in whom carcinoma, inflammatory lesions, post-bulbar ulcer, and adhesions are likely causes of duodenal obstruction, differential diagnosis is more difficult; visualization of these latter conditions as abrupt, smooth, and concentric is unusual. Diagnosis is difficult also when there is little or no obstruction and in the case of complete underlying atresia.

The author sees no contraindication to the use of a contrast medium in roentgen study of annular pancreas. He recommends 6 to 8 c.c. of an iodized oil such as Lipiodol or Iodochlordene in infants.

Ten roentgenograms.

Radiographic Diagnosis of Carcinoma of Head of Pancreas. Glenwood L. Cook. South. M. J. 48: 1277-1280, December 1955. (Jones County Community Hospital, Laurel, Miss.)

A proved case of adenocarcinoma of the head of the pancreas in a forty-three-year-old male is reported, with particular attention to the pyelographic findings. It is emphasized that these are supplementary to the conventional gastrointestinal signs and not diagnostic of themselves, inasmuch as renal and other extrarenal malignant growths may produce similar changes. In the author's case, an excretory pyelogram taken at the end of ten minutes revealed the right renal pelvis to be thinned out and the calyces obliterated as a result of pressure from the enlarged head of the pancreas. The gastrointestinal findings are also described.

Four roentgenograms.

Fatal Pancreatic Necrosis Following Choledochotomy and Cholangiography. Report of a Case. John E. Hershey and Frederick J. Hillman. Arch. Surg. 71: 885-889, December 1955. (University of Washington School of Medicine, Seattle, Wash.)

The authors report a fatality in a man of thirty-nine following cholangiography which resulted in a severe pancreatitis. At cholecystectomy the gallbladder was found to be thickened and to contain small irregular stones. The wall of the common duct was also thickened and edematous, and the lumen measured only 4 mm. After a No. 14 short-limbed "T" tube was sutured in place, two cholangiograms were taken with injection of 15 c.c. of 35 per cent iodopyracet (Diodrast) for each. On the second film, the full length of the pancreatic duct was well demonstrated. About twelve hours later, shock developed, with diaphoresis, dyspnea, and a weak pulse. The serum amylase rose to 600 units but by the third day had dropped to 178. A diagnosis of acute pancreatitis was made. Death occurred on the sixth postoperative day. Autopsy showed acute pancreatic necrosis. The duct of Wirsung joined the common duct 1 cm. proximal to the papilla. The duct of Santorini entered that of Wirsung. The liver was fatty and greatly enlarged.

Reflux injection of bile and iodopyracet along the pancreatic duct and excessive pressure in the presence of stenosis and spasm of the sphincter of Oddi were

considered the most likely cause of pancreatic necrosis in this case. Howell and Bergh (Gastroenterology 16: 309, 1950. Abst. in Radiology 57: 457, 1951) are said to have found elevation of serum amylase in 25 of 27 cases in which pancreatic reflux followed cholangiography. This usually paralleled the degree of pressure of the injection.

It is recommended that for cholangiography injections be of small volume, that the pressure be kept below 30 cm. of water, and that a gravitational technic be employed.

One roentgenogram; 2 photomicrographs; 1 photograph.

WILLIAM SNOW, M.D.
Shreveport, La.

Roentgenographic Opacity of the Hepatic Circulation. Alejandro Celis, Maria Elena Villalobos, H. del Castillo, and Jorge Flores Espinosa. Am. J. Roentgenol. 74: 1089-1095, December 1955. (A. C., Hospital General de México, México, D.F.)

The authors present a new method for the roentgenologic study of the liver by the injection of a radiopaque contrast medium into the suprahepatic vascular system. The study was carried out on cadavers, dogs, and in human subjects in whom there was no sign or symptom of liver disease.

In the living subject, a catheter was introduced into the left or right external jugular vein and advanced through the subclavian vein, superior vena cava, right auricle, and inferior vena cava, into the suprahepatic vein. Fifteen to 30 c.c. of a 70 to 80 per cent Nostylan solution was used, being injected as rapidly as possible. This procedure was carried out successfully in thirty cases, with no clinical evidence of hepatic damage in any instance. The suprahepatic venous system and the parenchyma of the catheterized lobule were visualized. The opaque substance enters the portal vessels against the portal blood flow.

It is believed that further studies will show this method to be of assistance in the study of pathological cases with changes in the hepatic vessels.

Eight roentgenograms.

THEODORE E. KEATS, M.D.
University of Missouri

The Diagnosis of Operable Portal Obstruction in Children. Natalie Schuckmann, William J. Grove, and Alexander P. Remenichik. Am. J. Dis. Child. 90: 692-700, December 1955. (University of Illinois College of Medicine, Chicago 12, Ill.)

The anatomy of the portal system is reviewed and the various congenital and acquired intrahepatic and extrahepatic causes of portal obstruction are enumerated. The authors are concerned particularly with portal hypertension in children. Accurate diagnosis of the cause, including the site of obstruction, may suggest the appropriate treatment and thus prevent such complications as hemorrhage from esophageal varices and pathologic depression of erythrocyte, leukocyte and platelet levels due to hypersplenism. Esophagoscopy is considered more dependable than roentgen examination for the detection of varices.

Splenoportal venography is the most promising method for delineation of the portal venous system and site of obstruction. The technic is briefly described and 4 cases are cited, 2 of extrahepatic and 2 of intrahepatic obstruction. Less than 50 pediatric cases are on record in which this procedure has been used. In

none of these have any undesirable effects been observed.

One roentgenogram; 5 drawings; 3 tables.

H. G. PETERSON, JR., M.D.
New Britain, Conn.

Roentgen and Autopsy Evaluation of Percussion of the Liver and Spleen. Samuel Zelman and Clarence M. Pickard. *Gastroenterology* 29: 1037-1045, December 1955. (S. Z., Winter Veterans Administration Hospital, Topeka, Kans.)

Percussion estimates of liver and spleen size in 100 living patients and 29 cadavers were compared with gas-contrast roentgen visualization and autopsy measurements in the respective groups. Percussion of the liver by a single qualified examiner was possible in nearly all cases, but the borders of the spleen could be identified in only 60 per cent of the subjects. All roentgen measurements were independently made by a single observer after administration of seidlitz powders and rectal insufflation of air.

Correlation of the measurements revealed acceptable percussion indices for groups but proved unreliable for evaluation of the individual patient. The examiner's impression of the reliability of his percussion in any individual case did not prove justified. The method of percussion, whether light or heavy, made little difference in the validity of the findings.

Six figures.

DALE UNDEM, M.D.
University of Louisville

Biliary Dyssynergia: Report of Two Cases. A. Strelinger. *Am. J. Digest. Dis.* 22: 345-349, December 1955. (650 N. Broad St., Elizabeth, N. J.)

Two somewhat unrelated cases are presented; the first apparently a stricture at or near the termination of the common duct occurring after cholecystectomy; the second, chronic cholecystitis in which the emptying pressure of the gallbladder was increased but no stenosis could be found. In the second case the common duct was normal. The first was relieved by an anastomosis between the duodenum and common duct and the second by cholecystectomy. Both patients had pain preoperatively.

Nine roentgenograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Experience with Five Orally Given Cholecystographic Mediums. Everett E. Seedorf and William N. Powell. *J.A.M.A.* 159: 1361-1362, Dec. 3, 1955. (E. E. S., 405 Main St., Peoria, Ill.)

Five series of 100 cholecystograms each were obtained with five cholecystographic media: iodophthalein sodium (Iodeikon) 4.0 gm., iodoaliphonic acid (Priodax) 3.0 gm., 2-(4-hydroxy-3-5 diiodo-benzyl)-cyclohexane carboxylic acid (Monophen) 3.0 gm., iopanoic acid (Telepaque) 2.0 gm., iophenoxic acid (Teridax) 3.8 gm. These were compared clinically as to quality of the produced cholecystograms, side-reactions, and pseudoalbuminuria.

No statistics are given concerning the quality of the cholecystograms. Priodax, Telepaque and Teridax are considered of equal "diagnostic value," though it is emphasized that Telepaque produces the densest gallbladder shadow and better demonstration of the cystic duct. The failure of Telepaque to dissolve completely in the intestine is considered a disadvantage. Resid-

ual amounts of this contrast medium might be confused with pathological abdominal calcifications.

Clinical experience appears to indicate that obscuring intestinal gas shadows occur less frequently with Teridax than with other media. With regard to side reactions, Priodax, Telepaque, and Teridax are tolerated quite similarly. Increased untoward side-reactions are seen with Iodeikon.

All of the newer contrast media cause a false positive urine test for albumin from the first to the third or fourth day following ingestion of the medium in 14 to 17 per cent of the cases. If the hot Exton's reagent is allowed to cool before interpretation, the incidence of a false positive test is increased to from 50 to 65 per cent. This may be of importance for the patient's health record.

Three tables.

G. A. DOEHNER, M.D.
St. Vincent's Hospital, N.Y.

Oral Cholecystography with Iopanoic Acid (Telepaque). Lawrence Reynolds and Harold Fulton. *J.A.M.A.* 159: 1358-1361, Dec. 3, 1955. (L. R., 101 Peterboro St., Detroit 1, Mich.)

To illustrate various features of cholecystography with iopanoic acid (Telepaque), 1,000 consecutive examinations with this medium were reviewed.

The dosage used varied between 2 and 8 gm. according to the body weight of the patient and averaged 3.47 gm. The gallbladder was visualized in 91 per cent of the series. Calculi were demonstrated in 15 per cent of the visualized and 18 per cent of the non-visualized gallbladders. Repeated "double dose" examinations done in 90 cases of non-visualization resulted in poor visualization of the gallbladder in 4.4 per cent and repeated non-visualization in the remaining 95.6 per cent. In 100 per cent of these 90 cases the lower dose allowed accurate prediction of gallbladder disease, thus rendering the value of a "double-dose examination" questionable.

Repeated "half-dose" examinations (1-2 gm.) done in an indeterminate group of patients with good to excellent visualization yielded the same results as the "normal dose" examination, thus casting doubt on the value of doses in excess of 3 gm.

One routine film taken twenty minutes after ingestion of a standard fat meal showed opacification of a normal common duct in 58 per cent of cases in which the gallbladder was visualized and a normal hepatic duct in 42 per cent of the 58 per cent. Therefore, filling of the hepatic duct, in particular its distal 1 to 2 cm., does not necessarily indicate obstruction of the common duct or papilla. Increasing dosage above 2 gm. did not influence the percentage of duct filling. This depends merely on the degree of gall-bladder filling and could probably be demonstrated more frequently by serial post-cubum films.

A roentgenographic technic using 70 to 80 kv, 0.1 to 0.3 second, and 200 to 400 ma was considered preferable to high-voltage technique of 90 to 115 kv. An upright or lateral decubitus film is considered essential for visualization of small concrements. The latter may occasionally be obscured by very dense filling of the gallbladder. Compression fluoroscopy with spot filming and—less conveniently—laminography may obviate this possible source of error in selected cases.

Six roentgenograms; 3 tables.

G. A. DOEHNER, M.D.
St. Vincent's Hospital, N.Y.

Intravenous Cholecystocholangiography. William H. Shehadi. J.A.M.A. 159: 1350-1353, Dec. 3, 1955. (345 W. 50th St., New York 19, N. Y.)

This paper relates to the use of Cholografin (sodium iodipamide) for intravenous cholecystocholangiography. The major uses of this medium are: (1) visualization of the bile ducts in cholecystectomized patients and in patients whose gallbladders fail to visualize after oral administration of a radiopaque material, due either to disease or to faulty absorption because of disturbed function of the gastrointestinal tract; (2) visualization of the gallbladder when orally administered media have failed; (3) prompt evaluation of the biliary tract for the differential diagnosis of acute conditions, especially when surgery is considered.

The patient is placed supine with the left side elevated 15 to 30 degrees. The gallbladder, when present, is at a higher level in this position and the heavier bile will flow out of it more readily, giving a more intense duct shadow after a fatty meal. Films are inspected as taken, to allow for corrections of position and technic.

In 90 per cent of cases Cholografin appears in the ducts immediately. In 10 per cent it is excreted entirely by the kidneys. Simultaneous hepatic and renal excretion occur without evident liver disease. After liver excretion, Cholografin is eliminated through the intestine, with no evidence of reabsorption. Visualization of bile ducts occurs as early as ten minutes after the injection is completed. Films are made at ten-minute intervals up to sixty minutes. Optimum visualization of the biliary tree is obtained at thirty to forty minutes. The gallbladder is often seen as early as ten to twenty minutes after injection, but usually at about two to two and a half hours. Once the gallbladder is filled, the examination should be completed in the same manner as with cholecystography. In cholecystectomized patients the examination should be completed in one hour. With partial obstruction due to inspissated bile at the end of the common duct, a longer time may be required. In the presence of jaundice (degree not stated), bile ducts cannot be visualized.

Duct measurements on several hundred normal patients were made. The hepatic and common ducts are practically of equal caliber and measure 0.5 to 0.6 cm. A 0.1 to 0.2 cm. measurement is often obtained in the phase of relaxation of the sphincter of Oddi following rapid emptying of the duct. The cystic duct measures 0.2 to 0.3 cm. Departure from these measurements, if constant, is considered abnormal.

Four roentgenograms; 1 table.

F. F. RUZICKA, JR., M.D.
St. Vincent's Hospital, N. Y.

Intravenous Cholangiography in the Postcholecystectomy Syndrome. By John L. McClenahan, John A. Evans, and Paul W. Braunstein. J.A.M.A. 159: 1353-1357, Dec. 3, 1955. (J. L. McC., 525 E. 68th St., New York, N. Y.)

One hundred and twenty-one persons with symptoms of the so-called post-cholecystectomy syndrome were examined by intravenous cholangiography. Also examined were a control series of 46 patients who were symptom-free after cholecystectomy.

In 80 per cent of the 121 symptomatic patients the common bile duct was visualized. In 33 per cent of this group various duct abnormalities were demonstrated. The most common finding was the cystic duct stump

(16.5 per cent), which in one-fifth of the cases contained calculi. Also noted were marked angulation, distortion, or stricture of the common duct (7.4 per cent), calculi in the extrahepatic ducts (9.1 per cent), and dilatation of the common duct (7 mm. was used as the upper limit of normal on the postero-anterior view with 40-inch target-film distance). Greater dilatation of the common duct was noted with stones than with persistent duct stump, stricture, and adhesions. In 24 per cent of the symptomatic group the only abnormality noted was dilatation of the common bile duct (this group presumably includes patients with fibrosis or reflex spasm of the sphincter of Oddi).

Every type of duct lesion (including stones) found in the post-cholecystectomy syndrome was demonstrated also in the control series. The incidence of duct disorders was almost identical in the two series except that small cystic duct remnants were seen almost twice as frequently in the control group. In both groups the mean diameter of the common duct was 9.0 mm.

It is the opinion of the authors that, rather than producing the post-cholecystectomy syndrome, surgery simply failed to relieve it. Cause for the complaint may be mechanical irritation or obstruction of the common duct because of stone or cystic duct remnant, or functional spasm and incoordination (biliary dyskinesia) of the sphincter of Oddi. Extrahepatic disease, such as duodenal ulcer or pancreatitis and liver parenchymal disease, must also be considered.

The study showed an almost constant common duct dilatation after cholecystectomy, both with and without symptoms. The authors feel that dilatation of the common duct usually results when disease or surgical resection deprives the body of a concentrating and distensible reservoir in the gallbladder.

Four roentgenograms; 1 graph; 4 tables.

F. F. RUZICKA, JR., M.D.
St. Vincent's Hospital, N. Y.

Cholangiography in Hepatic Hydatid Disease. W. R. Probert. Brit. J. Surg. 43: 308-309, November 1955. (Royal Buckinghamshire Hospital, Aylesbury, England)

A case of hydatid cyst of the left lobe of the liver (*Echinococcus granulosus*, microscopically confirmed) with intrapulmonary rupture is reported. The biliary tract was unexpectedly outlined by a sialogram done with Lipiodol introduced through a drainage tube to determine the size of residual postoperative intrahepatic cavitation. It was felt that in this case an infected cyst had been followed by a subphrenic abscess and a bronchial fistula. Following the x-ray examination, the drainage tube was removed. Three years later, the patient was free of chest symptoms; she had gained weight and was in good health.

Two roentgenograms. JULIO O'LACO, M.D.
Mercy Hospital, Pittsburgh

Precipitation of Contrast Medium in the Gallbladder. Report of a Case. Georg Theander. Acta radiol. 44: 467-470, December 1955. (Malmö Allmänna Sjukhus, University of Lund, Sweden)

The author reports a case in which the contrast medium used for cholecystography appeared to have caused a radiopaque precipitate in the gallbladder. As far as he is aware, no similar case is described in the literature.

The patient was a 30-year-old woman, with signs and

symptoms of acute and chronic biliary tract disease. She was given 3 gm. of Telepaque on Feb. 16, repeated on the following day. The gallbladder was not outlined, but in the right hypochondrium there was a large area of increased density, 7 by 12 mm. in size, presumably in the gallbladder. This was of similar opacity to the clumped medium in the bowel.

Cholegraphy on Feb. 24, with Biligrafin, definitely showed the mass to be in the gallbladder. It was no longer demonstrable on March 25, when the examination was repeated because of another attack of typical biliary colic.

The author feels, beyond a doubt, that the opaque formation in the gallbladder consisted of a precipitate of Telepaque or of some iodide part or product of this substance surrounding a few of the gallstones which were demonstrated on the examination of Feb. 24. The exact cause of the precipitation is not definitely known, but it is believed to have been due to some pathologic condition in the gallbladder. Being a highly complex fluid, the bile may possibly contain several factors influencing the solubility of contrast media. In bile of pathologic composition—suggested in the present case by the occurrence of gallstones—contrast media might be less soluble and thereby be precipitated. Another factor to be taken into consideration is the low solubility of the calcium salt of Telepaque.

Five roentgenograms. P. O'BRIEN, M.D.
Bowman Gray School of Medicine

Studies of the Reservoir Function of Normal and Inflamed Gall Bladders in Dogs. William C. Shoemaker, Alex W. Ulin, and Joseph M. Gambescia. *Gastroenterology* 29: 1024-1036, December 1955. (A. W. U., Hahnemann Medical College and Hospital, Philadelphia, Penna.)

The need for a diagnostic test which will circumvent the present limitations in diagnosis of common duct obstruction, non-calculous cholecystitis, non-visualizing gallbladder, and other abnormalities of the biliary tract prompted the experimental demonstration of the use of sodium dehydrocholate as a means of appraisal of the reservoir capacity of the gallbladder.

The normal dog gallbladder responded promptly to the intravenous injection of 0.8 gm. of sodium dehydrocholate by doubling in capacity, with most of the dilatation occurring within five minutes. Following the production of cholecystitis with intravenous Dakin's solution, the response was markedly retarded in both time and degree. With the common bile duct canalized, pressure recordings following the administration of sodium dehydrocholate revealed a slow rise in pressure concomitant with slow incomplete distention of the inflamed gallbladder, but a sudden sharp rise occurring after complete distention of the normal gallbladder.

Following cholecystectomy, there is an increase in common duct pressure which reaches a peak in about fifteen minutes in the normal common duct, suggesting a progressive dilatation as a compensation for the lack of a gallbladder. In complete common duct obstruction, the pressure rises sharply to high levels.

The reservoir capacity of the biliary system depends upon the elasticity of the gallbladder wall and this property is diminished in proportion to the amount of injury in the inflamed organ. Further study of the clinical use of sodium dehydrocholate for evaluation of the loss of distensibility and reservoir capacity and

thus the degree of gallbladder impairment is justified by these findings.

Eight roentgenograms; 1 photomicrograph; 7 graphs. DALE UNDEM, M.D.
University of Louisville

THE DIAPHRAGM; HERNIA

Subphrenic Abscess. C. J. Windsor. M. J. Australia 2: 190-199, Aug. 6, 1955. (Brisbane, Australia)

This paper is based on a review of the literature and a study of 100 cases of subphrenic abscess seen in the civilian general hospitals of the Brisbane (Australia) area from 1930 to 1954.

The subphrenic region lies between the diaphragm and the transverse colon and mesocolon. This large space is divided by the liver into suprahepatic and infrahepatic compartments, the former being subdivided into right and left portions by the falciform ligament. The right suprahepatic space was the most frequent site of involvement in the present series, followed by the right subhepatic space. In 20 cases the abscess was on the left side and in 5 it was bilateral.

As a rule, the infection has its source in the abdomen, and is the result either of an acute abdominal crisis or of operative intervention giving rise to a generalized peritonitis.

The clinical picture is variable. Radiography is essential both for recognition of the condition and its localization. The roentgen findings are considered under three headings: (1) pulmonary, present in 30 of the present series, including pleural reaction, basal congestion, patchy consolidation, and basal atelectasis; (2) diaphragmatic, including elevation, loss of mobility, thickening, and tenting; (3) subphrenic, consisting solely in the presence of gas or a fluid level. This last is a late finding and the only one truly diagnostic of a subphrenic abscess. A lateral recumbent view showing a shift of the gas shadow and fluid level may indicate the extent of the lesion.

Artificial pneumoperitoneum is mentioned without enthusiasm as possibly having a small part to play in diagnosis. The author cites one positive result without stating the number of times the procedure was attempted or the number of negative results encountered.

Complications and treatment are discussed at length. The great frequency of intrapleural involvement is stressed. Aspiration of the subphrenic region either for diagnostic or therapeutic purposes is condemned. Pleural aspiration may sometimes be indicated, but care must be taken that the tip of the needle does not pass beyond the confines of the pleural cavity. The treatment is surgical, with extraperitoneal drainage.

Six roentgenograms; 5 drawings; 3 graphs; 4 tables. J. E. CARLISLE, M.D.
Shreveport, La.

Strangulated Diaphragmatic Hernia with Torsion of the Stomach. T. Holmes Sellors and Cornelio Papp. Brit. J. Surg. 43: 289-292, November 1955. (London, England)

Strangulation of a diaphragmatic hernia is a rare condition and when present is usually associated with traumatic varieties rather than with the esophageal hiatus group of hernias. The mortality is high, approaching 90 per cent. Early diagnosis is very difficult and there is rapid progression of symptoms after an insidious onset. Abdominal signs are minimal and

in general the clinical picture is more suggestive of a chest condition, such as angina or infarction. Within a short interval the strangulated intrathoracic portion of the stomach distends, giving rise to diminished chest movements and hyperresonance until these signs are obscured by those of pleural effusion. Often the mediastinum is displaced and difficulty in breathing is constant. This is followed by rapid deterioration and shock.

On radiologic examination, the air-containing loculus may be seen in the thorax. This can easily be mistaken for a tension cyst, hemothorax, or a high diaphragm. It may be obscured by a large effusion. Diagnosis is always difficult unless the possibility of an intrathoracic loculus of the stomach is considered.

The authors present one case of strangulated hiatus hernia associated with torsion in the long axis of the stomach. The patient was a heavy, 66-year-old male admitted with a history of sudden onset of severe colicky pain in the epigastrium with spread to the left shoulder accompanied by repeated vomiting. Examination showed no evidence of an acute abdominal condition. There was definite dullness in the left lower chest. Four years previously the patient had been found to have a moderately large diaphragmatic hernia. The radiographs taken at the time of the strangulation showed great dilatation of the stomach, with part lying above the diaphragm. The two large sacs were in communication but no barium passed to the antral end of the stomach. Operation confirmed the diagnosis of a strangulated hernia and was followed by recovery.

Five roentgenograms; 7 drawings.

HILTON RODRIGUEZ DELGADO, M.D.
Mercy Hospital, Pittsburgh

THE MUSCULOSKELETAL SYSTEM

The Roentgen Manifestations of Early Joint Disease.
Doris E. Pipkin, Jack Moshein, and Everett L. Pirkey.
Am. J. Roentgenol. 74: 1030-1036, December 1955.
(E. L. P., Louisville General Hospital, Louisville 2, Ky.)

Since the advent of antibiotic therapy, radiologists are beginning to see joint infections which run their course without bone destruction. This paper analyzes the early joint changes of the hip in tuberculosis, pyogenic infections, Perthes' disease, hemophilia, and osteochondritis dissecans as they involve the soft tissues, the joint space, the joint surface, and bone.

Soft-tissue edema and atrophy are the earliest signs of joint disease. The joint space shows widening from effusion and thickened synovia or narrowing from atrophy. Subluxation occurs in infants. Narrowing is rarely an early sign except in post-traumatic osteoarthritis, where it follows atrophy of the articular cartilage.

Changes of the joint surfaces usually occur late except in osteochondritis dissecans and Perthes' disease, where they may be seen early. Demineralization is common in all forms of joint disease. It is due in part to increased circulation and disuse atrophy. Increased density and cystic areas are occasionally seen.

The changes described, coupled with the history and physical findings, should aid in early recognition of joint disease.

Fifteen roentgenograms; 1 table.

J. A. CAMPBELL, M.D.
Indiana University Medical Center

Osteopetrosis—Report of Three Cases. L. P. Langelier. *J. Canad. A. Radiologists* 6: 51-59, December 1955. (Arthabaska, Quebec)

Two of the 3 cases of osteopetrosis reported here were in siblings and were of the more severe type, with almost total involvement of the skeleton, deformities from impaired healing of multiple fractures, and anemia caused by bony overgrowth of the marrow space. In 1 there was evidence of cranial nerve impairment produced by narrowing of the foramina in the base of the skull.

The third patient exhibited a milder form of the disease, with much less bone sclerosis, no anemia, and a history of only one fracture. Her disease was found by accident in the course of chest roentgenography for pneumonia.

Twenty-two excellent roentgenograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Idiopathic Hypoparathyroidism with Bony Demineralization and Cardiac Decompensation. Jerome L. Schulman and Harold Ratner. *Pediatrics* 16: 848-856, December 1955. (J. L. S., The Johns Hopkins Hospital, Baltimore, Md.)

In hypoparathyroidism the bones characteristically show a normal or increased density on roentgenographic study. There are a low serum calcium and high serum inorganic phosphorus level and an absence of renal insufficiency.

The authors report a case in a 12-year-old white girl with clinical and laboratory manifestations consistent with idiopathic hypoparathyroidism but with severe skeletal decalcification demonstrable on x-ray examination. There was evidence also of cardiac decompensation, and the heart was greatly enlarged. The patient responded well to intravenous injections of parathormone, as evidenced by a rise in urinary phosphorus, less dramatically to intravenous calcium to control tetany, and slowly to large doses of vitamin D (up to 200,000 units per day).

The hypocalcemic basis for the cardiomegaly and failure was first suspected from the electrocardiogram, which showed low voltage of the QRS complex and a prolonged S-T segment. Following initial digitalization there was a gradual return of the heart size to normal, with no recurrence of the decompensation when the serum calcium rose from its low of 3.6 mg./100 ml. No organic basis for the enlarged heart could be shown during prolonged study of the patient. The authors postulate that usually the tetany is treated long before the hypocalcemia can exert overt effects on the heart, thus explaining the rarity of cardiac changes.

This appears to be the third case reported in the literature of idiopathic hypoparathyroidism showing osteoporosis. The bone changes are attributed to the severity of the hypocalcemia.

Four roentgenograms; 2 charts; 1 photograph; 1 table.

SAUL SCHEPP, M.D.
Boston, Mass.

Chondrolystrophy Calcificans Congenita. Report of a Case. Walter G. Selakovich and J. Warren White. *J. Bone & Joint Surg.* 37-A: 1271-1277, December 1955. (Shriners' Hospital for Crippled Children, Honolulu, Hawaii)

Chondrolystrophy calcificans congenita is a relatively rare disorder of infancy characterized by numer-

ous punctate or discrete areas of calcification in the epiphyses. It has been reported under a variety of names including chondrodystrophia foetalis hypoplasia, dysplasia epiphysealis punctata, and stippled epiphyses. The condition appears more commonly in females than males in a ratio of 2 to 1. It does not appear to be hereditary but shows some familial tendencies. Associated abnormalities are often present including cataract, cardiac defect, cleft palate, mental deficiency, microcephaly, oxycephaly, dwarfism, foot deformity, and monomelic shortening.

The combination of chondral dysplasia and "stippled epiphyses" is diagnostic of this condition if hypothyroidism is not present. The appearance of the stippling seen in cretinism may be so similar that correction by thyroid therapy may be the only distinguishing characteristic if the typical features of cretinism are not prominent. In hypothyroidism retardation of ossification centers is common, whereas the stippling in chondrodystrophia calcificans congenita usually occurs before the time when epiphyseal ossification would normally be expected.

The most common sites of roentgenographically demonstrated involvement are the upper and lower ends of the femur, tibia and fibula, the upper end of the humerus, the lower ends of the radius and ulna, the tarsal and carpal bones, and occasionally the pelvis, vertebrae, and the rib cartilages. The degree of involvement has varied considerably among reported cases, one or more extremities being affected.

A case is presented which gives a clear picture of the disease through close observation of the patient from twenty-five days of age through eleven years and three months. Such observations can be of definite aid in predicting the late deformities and thus suggesting the type of orthopedic treatment to be given.

On the initial study, the patient's right leg was smaller than the left but she was otherwise normal in appearance. Roentgenograms revealed discrete areas of calcific density in the acetabulum, sacrum, coccyx, right pubic bone, the distal femoral epiphysis, the proximal and distal epiphyses of the tibia and fibula, and in the tarsal bones of the right leg. Retardation of longitudinal growth of this leg was noted. Regular follow-up studies were carried out. Orthopedic procedures were done to increase the length of the right femur and to slow down the growth of the opposite leg. The final evaluation at eleven years and three months of age still showed a discrepancy in leg length and a saddle deformity of the nose.

Review of the serial roentgenograms showed that the stippling occurred in the right carpal and tarsal bones but these regions became relatively normal early and deformity here was slight. The vertebral bodies never showed stippling, but chondrodystrophic changes developed resulting in marked abnormalities quite similar to those seen in other forms of chondrodysplasia. A definite tendency for stippling to occur about the periphery of bones was noted. The pelvic bones which showed stippling developed normally, with no resulting deformities. Retardation of epiphyseal centers with slow irregular ossification was noted, but completion of ossification occurred at essentially the same time as on the normal side. The proximal end of the left femur showed no stippling, but the femoral head was large and the neck short and thick, as on the right side.

Nine roentgenograms. RICHARD P. STORRS, M.D.
Los Angeles, Calif.

Laminagraphy in Acute and Chronic Inflammatory Disease of the Petrous Bone. E. Muntean. *Acta radiol.* 44: 479-504, December 1955. (In German) (Röntgeninstitut der Gebietskrankenkasse für Arbeiter und Angestellte, Graz, Austria)

For studying the petrous bone simple laminographic lateral and postero-anterior views were chosen as routine positions because of ease of reproducibility. Only in occasional cases, especially to demonstrate the internal acoustic meatus, was a 45-degree oblique view (Stenvers') obtained. For fine detail a cone was used, with a proximal opening of 30 mm. diameter and a distal opening of 80 mm. Pendulum motion in the direction of the long axis of the body was employed.

The first part of the paper considers laminographic findings under normal conditions, comparing the lateral, postero-anterior, and Stenvers' views with an isolated specimen of the bone. The wealth of anatomic detail obtainable is immediately apparent.

Under another heading the author deals with the use of this method in acute inflammations of the middle ear (mastoiditis and osteomyelitis). It is pointed out that clouding of the mastoid cells alone is no sign of mastoiditis, since about 50 per cent of clouding comes from an uncomplicated otitis media without mastoiditis. The positive roentgenologic signs are erosion of the cell septa and inflammatory osteoporosis. Laminagraphy can demonstrate the areas of destruction which are not visualized on the plain studies. Such a study is especially indicated in those processes that have been held in check, but not completely eradicated, by modern therapeutic methods.

The third part of the paper discusses the application of laminagraphy in different forms of chronic otitis media. It is here that the method achieves its fullest usefulness. Plain films are often of no aid other than indicating the degree of aeration of the mastoid cells. The poorly aerated petrous bone is precisely that type most liable to chronic infections and least susceptible to adequate interpretation by routine roentgenography. It is only by the laminographic demonstration of bone erosion (tegmen, wall of lateral sinus, aditus, semicircular canals, facial canal, posterosuperior wall of external meatus, etc.) that a positive x-ray diagnosis of chronic middle ear inflammation can be offered. The lateral laminagram has the advantages over the Mayer projection that the component parts are not distorted but are visualized just as the surgeon encounters them at operation.

Laminagraphy is most useful in diagnosing cholesteatomas, which pose an extremely difficult problem when only plain roentgenography is used. The postero-anterior laminogram may demonstrate the cholesteatoma breaking through the posterosuperior wall of the external meatus; the width of the aditus is also well demonstrated. Even with laminagraphy, however, the diagnosis of cholesteatoma still remains difficult.

Seventy-four illustrations.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

The Incidence of Scoliosis in the State of Delaware. A Study of 50,000 Minifilms of the Chest Made During a Survey for Tuberculosis. A. R. Shands, Jr., and Harry B. Eisberg. *J. Bone & Joint Surg.* 37-A: 1243-1249, December 1955. (Alfred I. du Pont Institute, Wilmington, Del.)

In the fall of 1953, in Delaware, 194,600 chest roent-

genograms were made on 70-mm. roll film during a survey for tuberculosis. The total number represented 82.2 per cent of the adult population over fourteen years of age. The authors examined 50,000 of these minifilms and found evidence of scoliosis in 936 (1.9 per cent). The films showing scoliosis were analyzed according to (1) the sex, race, and age of the subject and (2) the magnitude of the curvature and direction and level of its apex. An attempt was made to determine the etiology of the condition in the first 15,000 films. Curves with angles between 10 and 19 degrees were recorded as mild; those between 20 and 29 degrees as moderate; and those over 30 degrees as severe.

Mild curves accounted for 75.2 per cent of the series, moderate 14.2 per cent, and severe 10.6 per cent.

The rate per thousand was 9.3 for males and 27.7 for females, a ratio of approximately one to three. The total number of moderate and severe curves in males, however, was 2.8 per cent higher than the total number for females. The analysis according to race showed essentially the same incidence rate for Negroes as for whites, but the total number of moderate and severe curves in the Negro was 9 per cent higher than the total number in the white.

The highest incidence occurred in the age group fifteen to nineteen years of age, the rate for this group being 31.2 per thousand. In the group fifty to fifty-nine years, the rate dropped to 14.8 per thousand, but in the group 70 or over it went up again to 21.2.

Of 230 cases among the first 15,000 films examined, approximately two-thirds appeared to be of a postural or functional type and one-fourth of an idiopathic type. The convexity of the curve was to the right in 81 per cent of cases.

The authors conclude that, in spite of the many errors inherent in basing a study of bone pathology on roentgenograms made for a study of soft tissue, such a study presents as accurate a picture as can be obtained of the incidence of scoliosis in any general population along the Eastern Seaboard.

Three roentgenograms; 7 tables.

RICHARD P. STORRS, M.D.
Los Angeles, Calif.

The Spondylitis of Juvenile Rheumatoid Arthritis.
Robert E. Barkin, J. Sydney Stillman, and Theodore A. Potter. *New England J. Med.* 253: 1107-1110, Dec. 22, 1955. (Harvard Medical School, Boston, Mass.)

Fifty-seven of a series of 71 patients with juvenile rheumatoid arthritis were found to have clinical or x-ray evidence of spinal involvement, most commonly in the neck and lower back. In the 49 patients showing x-ray changes, the chief features were narrowing, irregularity, and often fusion of the apophyseal joints, as well as of the sacroiliac joints, similar to the process in the peripheral joints. Accompanying these direct changes were underdevelopment in height and breadth of the vertebral bodies in the affected areas, with narrowed intervertebral disk spaces, thought to be secondary to limitation of motion, which is a normal stimulus to growth. Only 2 patients showed calcification of paravertebral ligaments.

X-ray changes may become evident within a few months of the onset of the disease and may progress rapidly.

Spondylitis was about equally frequent in males and females. In this group, rheumatoid spondylitis was

accompanied by peripheral joint involvement in every instance.

Seven roentgenograms; 1 photograph; 2 tables.

H. G. PETERSON, JR., M.D.
New Britain, Conn.

Herniation of Intervertebral Discs. An Evaluation of the "Indirect Signs." A. Justin Williams and Tom Fullenlove. *California Med.* 83: 433-434, December 1955. (A. J. W., 450 Sutter St., San Francisco 8, Calif.)

Commonly accepted indirect signs of intervertebral disk herniation, demonstrable on plain films of the spine, are narrowing of the disk space, flatness of the lordotic curve, scoliosis, and localized hypertrophic spur formation. None of these do the authors regard as reliable evidence of a herniated disk.

Narrowing of the disk space is of no diagnostic value whatever in posterior herniation. It is not to be considered clinically significant unless there is a definitely demonstrable intrusion of the superior facets of the sacrum into the neural foramina. Lessening of the lumbar lordosis, or flatness of the back, is associated with many conditions producing muscle spasm. Scoliosis is also a manifestation of muscle spasm, while spur formation occurs frequently in persons without evidence of disease, as a result of posture or trauma.

Two series of patients were examined for the four signs listed above: 60 in which disk herniation was proved at operation and 200 asymptomatic industrial workers. Except for scoliosis, the incidence of the indirect signs was slightly greater in the presence of known herniation, but the difference in the two series was not sufficient to be of significance.

[The title of this article would imply discussion of herniation of intervertebral disks in general but the signs analyzed pertain predominantly to posterior herniation, presumably the type producing neurological findings.—J. W. B.] JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Ruptured Thoracic Discs. Norman H. Horwitz, Benjamin B. Whitcomb, and Francis G. Reilly. *Yale J. Biol. & Med.* 28: 322-330, December 1955-February 1956. (Hartford Hospital, Hartford, Conn.)

Rupture of a thoracic disk, though uncommon, is probably underdiagnosed. Two distinct types occur: (1) central herniation producing cord pressure with long tract signs, (2) lateral herniation resulting in nerve root pressure with radicular signs and symptoms. Report is made of 5 cases, surgically proved. Plain film findings were not diagnostic: in some instances mild narrowing of the disk space or even calcification of the disk was noted; in others films were negative. All 5 cases presented positive myelographic findings and in all 5 there was definite elevation of the protein content of the spinal fluid.

Difficulty in establishing the lateral defect in thoracic myelography is again stressed. The authors strongly recommend the making of several exposures as the contrast material passes into the suspected area. A significant lateral defect should then be consistent on each of the several films.

The ruptured disks in this series varied in location in the dorsal spine; no areas appear to be immune.

Complete laminectomy is indicated for the centrally ruptured disks and hemilaminectomy for those displaced laterally.

The possibility of ruptured intervertebral disks in the thoracic spine should be considered as a cause for unexplained pain in the thorax and upper abdomen.

Three roentgenograms; 1 photograph.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Physiologic Vertebral Ligamentous Calcification: An Aging Process. Charles F. Smith, David G. Pugh, and Howard F. Polley. *Am. J. Roentgenol.* **74:** 1049-1058, December 1955. (Mayo Clinic and Mayo Foundation, Rochester, Minn.)

So-called physiologic ligamentous calcification is associated with decreased mobility of the spinal column in advancing age and is found in patients who have no symptoms of rheumatoid spondylitis. It was described by Oppenheimer in 1942 as ossification of longitudinal spinal ligaments unaccompanied by changes in vertebral bodies, disks, apophyseal joints, or sacroiliac joints (*Radiology* **38:** 160, 1942).

Fifty-three patients with this type of calcification were studied. Group I was composed of 21 patients with no symptoms referable to the back: 12 men and 9 women averaging sixty-five years of age. Four showed limitation of motion. Sedimentation rates were increased in about half of the cases examined, probably as a result of associated diseases.

Group II included 32 patients with back pain in whom a diagnosis of rheumatoid spondylitis could not be made. There were 24 men and 8 women, averaging 62.5 years. Symptoms were morning stiffness and sporadic vague pain which bore only superficial resemblance to the fibrositic distress of rheumatoid spondylitis. The average age at the onset of symptoms was 57.5, well beyond that usually seen in the latter condition. Laboratory findings were about the same as in Group I. Only degenerative changes were seen in the sacroiliac joints.

Roentgenologically, ligamentous calcification is most frequently seen in the thoracic spine, and that area is almost invariably affected in the presence of calcification of this type in the cervical and lumbar regions. The extent of the process varies from one or two vertebral interspaces to the entire length of the spine. The calcified ligament may reach a thickness of 5 to 10 mm. and frequently appears to be too long for the intervertebral space it must cover. It is usually homogeneous in density and distinct from the anterior margins of the vertebrae to which it is attached.

The condition is chiefly confused with degenerative osteoarthritis, but the osteophytes and calcified ligaments are easily distinguishable. It is presumed that physiologic ligamentous calcification may be the result of the relative immobility of the spinal column associated with advancing age. No correlation was found between trauma or occupation and the occurrence of this phenomenon.

Eight roentgenograms; 5 tables.

J. A. CAMPBELL, M.D.
Indiana University Medical Center

The Pathogenesis of Osteitis Pubis. Howard L. Steinbach, Nicholas L. Petrakis, Rutherford S. Gilfillan, and Donald R. Smith. *J. Urol.* **74:** 840-846, December 1955. (University of California Medical School, San Francisco 22, Calif.)

Evidence is reviewed in favor of each of the three theories currently available to explain the etiology of

osteitis pubis. Neither direct trauma to the bone nor infection secondary to suprapubic or subpubic surgery is supported as a causal factor by convincing experiments or observations. The authors favor the theory of impaired circulation to the symphysis and pubic rami and attempt in this report to explain the mechanism by which osteitis results. A technic of intra-osseous phlebography in which contrast material is injected rapidly under pressure into the venous sinusoids of the bones of the symphysis was used. In normal individuals the contrast material was found to escape rapidly into the pelvic venous channels of the pudendal, vesical, or prostatic plexuses. Two similar venographic studies performed in patients with osteitis pubis showed remarkable differences from this normal pattern. In each case, the contrast material collected in dilated, tortuous veins in and about the symphysis and pubic rami. Drainage to the deep pelvic veins was completely blocked or much impaired. In some instances the dilated venous channels corresponded well with small cortical erosions shown in the involved bones on preliminary roentgenograms.

On the basis of the above observations, the authors feel that osteitis pubis is due to impaired venous return secondary to either thrombophlebitis or to direct trauma to the pelvic vessels at the time of surgery. They explain the inflammatory sequelae on the basis of secondary bacterial invasion abetted by venous stasis. During the healing stage, the periosteum, which has been elevated from the underlying bone by the dilated veins and perhaps stimulated by low-grade associated inflammatory reaction, lays down ribbons of new bone to account for the observed sclerosis and bone fusion seen in the "healed" stage of osteitis pubis.

Eight roentgenograms. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Slipped Upper Femoral Epiphysis in Siblings. William Stanley Smith. *Ohio State M. J.* **51:** 1200-1201, December 1955. (Ohio State University College of Medicine, Columbus, Ohio)

Three examples of slipped upper femoral epiphysis occurring in 2 tall asthenic Negro brothers with no significant history of trauma are reported. The first was seen at the age of fifteen years with a painful left-sided limp which had developed over a five-month period. There were shortening of the left lower extremity of 1 1/2 inches, a marked external rotation, deformity of the left hip with limitation of internal rotation and a 15-degree flexion deformity. Roentgen examination showed a severe degree of slipping of the capital femoral epiphysis with epiphyseal closure and beginning reduction of the joint space.

In the second patient, thirteen years of age, the symptoms dated back six weeks. Two weeks prior to admission he had experienced a sharp pain in the groin while playing basketball, although there was no specific traumatic episode. There was 1 inch of true shortening of the left lower extremity, with marked limitation of internal rotation. Films revealed a severe degree of slipping of the capital femoral epiphysis with no evidence of fusion of the epiphysis and normal joint space.

Ten months after treatment of the left hip, the younger boy began to experience pain in the right groin and thigh. Serial x-ray examinations of the right hip showed progressive widening of the epiphyseal plate with development of cyst-like lesions of the neck of the femur adjacent to the epiphyseal plate. The final

films were interpreted as "pre-slipped upper femoral epiphysis."

The unusual features of these cases were their occurrence in siblings, the insidious development without evidence of trauma, and absence of hypogenitalism. The cases lend clinical support to the view that slipped upper femoral epiphysis represents a disturbance in epiphyseal physiology and that trauma more often reveals than causes the condition.

Four roentgenograms.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Epiphyseal Injury Following Frostbite. Jack R. Dreyfuss and Melvin J. Glimcher. *New England J. Med.* **253:** 1065-1068, Dec. 15, 1955. (Massachusetts General Hospital, Boston 14, Mass.)

A case of classic frostbite in a girl of two and a half years, followed by changes in six of the fourteen phalangeal epiphyses of the right hand, is reported. Both hands had been frostbitten, the right more severely. By the third week after exposure, the nails of the four fingers most involved had become detached and the skin down to the proximal interphalangeal joints "peeled off, like a glove." At no time was there any evidence of infection. Five or six months after the frostbite, the child's mother noticed flexion deformities of the distal interphalangeal joints of the second through the fifth finger of the right hand. About a year later, it was first noted that the fingers of the right hand, especially the distal phalanges, were shorter than those of the left.

The patient was seven years of age when first seen by the authors. The left hand at this time appeared normal, while the right hand, at rest, showed slight flexion of the distal interphalangeal joints of the second through the fifth fingers, most marked in the third and fifth fingers. The distal phalanges of the third, fourth and fifth fingers appeared clinically shorter and broader than those on the left, as did the middle phalanges of the fourth and fifth fingers. X-ray examination confirmed the phalangeal shortening and disclosed, in addition, complete absence of the epiphyses normally accompanying the distal phalanges of the third, fourth and fifth fingers, as well as that of the middle phalanx of the fifth finger. A tiny fragment of the secondary ossification center of the epiphysis of the distal phalanx of the second finger was present and also a portion of the secondary ossification center of the epiphysis of the middle phalanx of the fourth finger, which was partially fused with the shaft. In addition, at the articular surfaces there were numerous small rounded areas of demineralization.

The phalanges in which there was complete absence of the epiphyses showed no growth in five years when compared with the left hand and with serial films of normal children in the same age group. The middle phalanx of the right fourth finger shows a discrepancy in length that is somewhat less than would be expected if there had been complete destruction of the epiphysis and no growth. This is in keeping with the x-ray finding of a partially fused fragment of the secondary ossification center of this phalanx.

The range of epiphyseal injury, and the subsequent growth retardation, is probably related to the degree of vascular damage secondary to frostbite. Whether the hypothermic injury not only compromised the circulation but also caused death of the cartilage cells of the

epiphyses by the direct effect of freezing is unknown. One roentgenogram; 1 photograph.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Gout of the Patella. Report of a Case. Laval U. Peloquin and James H. Graham. *New England J. Med.* **253:** 979-980, Dec. 1, 1955. (St. Elizabeth's Hospital, Boston, Mass.)

The authors report the case of a 43-year-old male with pain and palpable lumps of four weeks duration over the knee. Roentgenograms showed an area of destruction in the patella, irregular in outline, with an area of bony proliferation on its anterior aspect. The cystic area of destruction eroded through the cortex. At operation 3 curettesfuls of partly calcified material were removed. Histologically this was characteristic of gout. The serum uric acid level was 8.3 mg. per 100 c.c.

According to the authors this is the only reported case of involvement of patella by gout without demonstrable disease in other bones. [A cyst of the patella due to gout was recently reported by Lyford and Shapiro (*Radiology* **66:** 380, 1956) but in that instance other joints were also involved.—Ed.]

One roentgenogram.

ALEXANDER R. MARGULIS, M.D.
University of Minnesota

Clinical and Roentgen Manifestations of Tarso-Epiphyseal Aclasis. Review of the Literature and Report of an Additional Case. G. J. D'Angio, Max Ritvo, and Robert Ulin. *Am. J. Roentgenol.* **74:** 1068-1080, December 1955. (M. R., 416 Marlboro St., Boston 15, Mass.)

The authors add a case of tarso-epiphyseal aclasis to 11 which they found in the literature. This developmental disorder is characterized by a painless eccentric cartilaginous overgrowth with consequent asymmetrical enlargement of the medial or lateral half of the epiphyseal ossification centers of the lower limb. Diffuse amorphous calcific stippling is scattered through the anomalous cartilaginous mass. When more than one epiphysis is involved, the changes are limited to either the medial or lateral aspects of the limb, e.g., the lateral and femoral tibial condyles and the lateral malleolus at the ankle. The calcifications increase with age. The bony enlargements may extend anteriorly or posteriorly.

The case reported showed diffuse involvement of the ossification centers of the astragalus, internal cuneiform, first metatarsal and proximal phalanx of the first toe on the left side, and medial involvement of the femoral and tibial epiphyses at the knee as well as the distal tibial epiphysis. There was also precocious appearance of the ossification centers of the patella and various tarsal bones.

The patient was followed for eight years, and showed progressive deformity of these bony parts plus a lengthening of the affected limb, a phenomenon not reported in other cases. Other features peculiar to this case were the involvement of so large a number of ossification centers, and of the lateral rather than the medial aspect of the epiphysis of the great toe.

Tarso-epiphyseal aclasis is to be differentiated from chondrodstrophy calcificans congenita, chondrodystrophy, dyschondroplasia, dysplasia epiphysialis multiplex, cretinism, aseptic necrosis, and calcified hematoma.

The etiology is unknown. The possible relationship of the hemi-epiphyseal distribution of the dysplasia and the epiphyseal blood supply was first mentioned by Trevor (J. Bone & Joint Surg. 32-B: 204, 1950. Abst. in Radiology 56: 622, 1951). Certain characteristics of the disease suggest the presence of local hyperemia. A possible relationship to vasomotor innervation is indicated by the close correlation between the segmental nerve supply of a single lumbar root and the characteristic bone pattern.

Eleven roentgenograms; 3 tables.

J. A. CAMPBELL, M.D.
Indiana University Medical Center

Footballer's Ankle. A. McDougall. Lancet 2: 1219-1220, Dec. 10, 1955.

The condition known as athlete's or footballer's ankle, affecting football players and associated also with other forms of athletic activity, is marked by bony outgrowths along the tibial margins beneath the malleoli and on the dorsum of the neck of the astragalus. It is a result of repeated minor strains of the capsular attachments of the ankle joint and repeated compression injuries of the bones when the ankle is forcibly dorsiflexed and plantarflexed. The posterior processes of the astragalus may be broken off, forming loose bodies in the joint.

Roentgenographic examination is diagnostic. The earliest change is peaking of the tibial margins, but the definite bony overgrowths subsequently become apparent.

It is believed that the condition is a form of traumatic arthritis of the ankle joint, in which the changes are limited to the articular margins because of the nature of the injury.

Seven roentgenograms.

THE SPINAL CORD

Tuberous Sclerosis With Involvement of the Cervical Cord. C. J. Lucas and S. David. Lancet 2: 1217-1219, Dec. 10, 1955.

The diagnostic importance of the roentgen findings in the skull and bones in tuberous sclerosis has only recently been recognized. The most characteristic changes are in the skull, where intracranial calcification of various types may be evident. In the form of small, discrete, multiple opacities, these alterations are said to be almost pathognomonic, but a sinuous type of calcification may also occur and the vault of the skull may show mottling or thickening. Intraventricular nodules, revealed by air encephalography, provide valuable confirmatory evidence of the diagnosis. In the hands and feet, cyst formation, periosteal thickening, and osteoporosis may be seen, singly or in combination. In the long bones, fibrocytic changes or small periosteal nodules may be observed.

The authors present a case in a 22-year-old man, in whom the diagnosis of tuberous sclerosis was made solely on the basis of the radiologic findings. The clinical picture, from which the usual features of the disease were absent, was one of damage to cranial nerves and cervical cord. Roentgen studies disclosed thickening of the skull, particularly in the frontal region, with changes extending to the floor of the anterior fossa. Intracranial calcification was both sinuous and nodular. The ischial bones showed a punctate increase in density, a finding not previously de-

scribed with reference to tuberous sclerosis. The hands and feet were normal. A lumbar air encephalogram revealed three small calcified nodules protruding into the left lateral ventricle and a fourth in the left frontal horn, with the probability of a fifth lying within the temporal horn. Electroencephalographic findings were slightly abnormal. A complete spinal myelogram by the lumbar route was normal, thus eliminating a neurofibroma or other extramedullary lesion with root involvement or cord compression as diagnostic possibilities.

Two roentgenograms.

Anterior Sacral Meningocele. Report of Two Cases. B. C. Rowlands. Brit. J. Surg. 43: 301-304, November 1955. (The Royal Infirmary, Sheffield, England)

An anterior sacral meningocele is a cystic presacral swelling caused by meningeal protrusion through a developmental defect in the anterior sacrum. It is a rare condition occurring more frequently in females. Only 54 cases have been reported in the literature, including the 2 presented in this paper.

Situated deep in the pelvis and being of a cystic character, the lesion may be asymptomatic. Symptoms when present are due to pressure of the sac on the anterior sacral rami, rectum, and bladder. Pressure on the sac by adjacent organs may be transmitted by way of the spinal canal, producing increased intracranial pressure, with headache.

The cystic nature of the lesion may distinguish it from solid presacral lesions such as teratoma, chondroma, plasmocytoma, and ependymoma. A presacral dermoid may present the same clinical and symptomatic manifestations and both are frequently found in females.

Radiological diagnosis is based upon the finding of a sacral defect demonstrable on a plain film. Unilateral agenesis of the lower sacrum with deviation of sacrum and coccyx to the opposite side is the most frequent finding, producing the so-called "scimitar sacrum." Both sides of the sacrum may be affected. Proof of the existence of the sac is obtained by myelography, when the radiopaque material gravitates into the sac from the lumbar subarachnoid space. This communication is often small, preventing immediate entry of the medium into the sac. Repetition of the examination after a week or more may therefore be necessary. Additional information may be afforded by barium enema and cystography.

A high mortality rate is associated with any radical or palliative procedure, meningitis being a frequent complication. Aspiration of the cyst has been followed by cure in some instances, but should not be attempted by way of the rectum or vagina, as fatal meningitis will invariably result.

One of the author's patients was first seen because of acute urinary retention. A large cystic mass occupying most of the pelvis and displacing the bladder was found at laparotomy and was evacuated. It refilled, however, in the course of seven months, causing bowel obstruction, which was relieved by a second aspiration. The patient had remained symptom-free up to the time of the report, nearly ten years later, but the meningocele had been considered a bar to normal delivery and an indication for cesarean section.

The second case was discovered while the patient was attending a contraceptive clinic. She was asymptomatic, but the pelvic roentgenogram showed the

characteristic "scimitar sacrum" and a barium enema study demonstrated rectal displacement.

Six roentgenograms.

HILTON RODRIGUEZ DELGADO, M.D.
Mercy Hospital, Pittsburgh

Compression of Spinal Cord and Cauda Equina in Achondroplastic Dwarfs. Joseph A. Epstein and Leonard I. Malis. *Neurology* 5: 875-881, December 1955. (230 Hilton Ave., Hempstead, N. Y.)

In the achondroplastic dwarf there is a congenital narrowing of the spinal canal, especially in the anteroposterior diameter, evidently due to a disorder in development which results in vertically short vertebrae with short, thick pedicles. In adult dwarfs, marginal exostoses on the vertebral bodies and articular facets cause further narrowing. The intervertebral disks are unusually thick and compensate, by reverse wedging, for wedging of vertebral bodies, which is often present at the lumbo-dorsal level. This predisposes to early disk degeneration and bulging of the annulus into the canal at multiple levels.

The spinal cord, which develops normally, is relatively too large, and encroaches upon the subarachnoid and epidural spaces. Thus, compression of the cord and cauda equina is fairly common.

While plain roentgenograms of the spine reveal the vertebral body and disk changes, myelographic study is needed for complete appraisal.

The authors report a case in a girl of fifteen, in whom the posterior surfaces of the lumbar vertebrae were unusually scaphoid, producing an undulating anterior profile in the spinal canal. The oil column broke up at each lumbar interspace, with coarse vertical striations, indicating extradural compression of the roots of the cauda equina. Caudal flow of the oil in the dural sac was delayed at the L1-L2 level, with complete block between L2 and L3.

Laminectomy performed over multiple dorsolumbar vertebral segments relieves compression of this type and, if performed early, makes possible complete return of function.

Seven roentgenograms; 1 drawing.

DON E. MATTHIESSEN, M.D.
Phoenix, Ariz.

GYNECOLOGY AND OBSTETRICS

The Value of Pelvic Arteriography in the Diagnosis of Mole and Chorionepithelioma. Ulf Borell, Ingmar Fernström, and Axel Westman. *Acta radiol.* 44: 378-384, November 1955. (U. B., Karolinska Sjukhuset, Stockholm, Sweden)

The trophoblastic cells of hydatidiform mole and chorionepithelioma penetrate and destroy the walls of the uterine blood vessels, resulting in the formation of blood-filled spaces in the uterine wall. In 2 cases of mole, pelvic arteriography revealed such characteristic changes in the uterine blood vessels that a correct preoperative diagnosis was made. An increased number of blood vessels with small areas of opacification within the tumor were significant findings. The opaque medium passed rapidly into large veins, suggesting arteriovenous shunts. Injection of the operative specimen of a chorionepithelioma showed similar arteriographic changes.

The technic described by Fernström (*Acta radiol.* Suppl. 122, 1955. Abst. in *Radiology* 66: 146, 1956)

was used for these studies. It is suspected that not all cases will show the described characteristics. Further elucidation of the value of the procedure will come only with its more routine application.

J. A. CAMPBELL, M.D.
Indiana University Medical Center

Roentgenologic Findings in Hydrops Fetalis. Milos Valenta. *Československá roentgenol.* 9: 49-56, 1955. (In Czech)

Hydrops fetalis is regarded as the most serious complication of erythroblastosis. Prior to delivery, the main roentgenologic findings are (1) edema of the soft tissues of the fetus, (2) diffuse osteosclerosis, and (3) signs of fetal death.

Recognition of osteosclerosis in the fetus requires technically perfect films and, even with these, comparison with a healthy fetus is recommended. Several similar conditions must be excluded, as osteopetrosis and syphilis. In hydrops, the sclerosis involves chiefly the ribs and long bones, and fractures practically never occur.

The frequently associated polyhydramnios makes it difficult to obtain good roentgenograms of the maternal abdomen with soft-tissue technic, to identify the Buddha position of the fetus (deflected head with raised and abducted arms). For this purpose, it is advisable to obtain oblique views, which will also show what the author believes to be a pathognomonic sign in hydrops, i.e., the "swimming limbs," a deflection and straightening of the lower limbs due to the enlarged fetal abdomen. This sign was absent in only 1 of the 6 observations he reports, and then because of breech position.

Hydrops fetalis would be diagnosed more often if routine prenatal roentgenograms in frontal, lateral, and oblique positions were obtained for all sensitized Rh-negative mothers; emergency films are advisable whenever the titer changes or the fetus shows signs of anoxia.

One roentgenogram; 1 photograph.

GEORGE I. PAPRIKOFF, M.D.
Cook County Hospital, Chicago

THE GENITOURINARY SYSTEM

Delayed Cystography and Voiding Cystoureterography. Charles Montgomery Stewart. *J. Urol.* 74: 749-759, December 1955. (2010 Wilshire Blvd., Los Angeles 57, Calif.)

Delayed cystography is a method of investigation of the urinary bladder and ureters by instillation of contrast material into the bladder by catheter and exposure of films at intervals thereafter. Voiding cystoureterography refers to radiographic examination of the bladder and lower ureters during micturition.

The author recommends filling of the bladder with 20 per cent Urokon within the limits of patient comfort. Over-distention is not necessary. Films are exposed at approximately fifteen-minute intervals up to a period of three hours, if necessary. By this means it is possible to demonstrate delayed reflux of contrast material into the lower ureters or upper collecting systems. Such reflux may be delayed or intermittent, unilateral or bilateral. The examination is completed by exposure of one or more films centered over the bladder as the patient stands and performs forceful voiding. Ureteral filling under these conditions is termed "voiding reflux."

By utilization of these technics the author has demonstrated ureteral reflux in cases in which it was totally unsuspected on conventional intravenous urography, retrograde studies, or cystoscopy. Such demonstration is considered particularly important in children and may explain persistent or intermittent urinary infections when all other studies have been negative. A "voiding reflux" may be recognized clinically by absence of residual urine in the bladder immediately following micturition, but rapid collection of urine two or three minutes later.

A brief discussion of treatment mentions surgical correction of bladder neck obstruction and a controlled regimen of frequent non-forceful urination to prevent voiding reflux.

Two cases in young children are reported.

Thirty-five roentgenograms.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Ureteral Reflux in Normal Infants. Guido Iannaccone and Paolo Emilio Panzironi. *Acta radiol.* 44: 451-456, December 1955. (Institute of Medical Radiology, University of Rome, Italy)

Fifty healthy infants ranging in age from ten days to six months were submitted to cystography with Joduron 20 per cent under varying intravesical pressures, without anesthesia.

In one case vesico-ureteral reflux was observed. The reflux was unilateral; the ureter and pelvis appeared normal; the contrast medium quickly disappeared from the pelvis and ureter, and repeated reflux could not be demonstrated at the same session or two weeks subsequently. Previous cystography at ten days of age had shown no reflux. The authors believe that the simultaneous occurrence of all or most of the foregoing features in a normal subject should lead to a diagnosis of "occasional" reflux.

These features are to be differentiated from those in pathologic conditions, in which reflux is often bilateral, the ureters and renal pelvis frequently appear enlarged, kinked, and atonic, the regurgitation can generally be visualized for a longer time, and the demonstration of reflux can usually be repeated at the same session or subsequently.

The true incidence of vesico-ureteral reflux in healthy subjects is perhaps higher than 2 per cent, since it may easily escape radiologic demonstration.

Rapid and transitory elevation of intravesical pressure during episodes of coughing and crying may possibly explain the mechanism of occasional reflux in healthy infants.

Six roentgenograms. P. MATHEWS, M.D.
Bowman Gray School of Medicine

Biophysical Investigations of Urinary Calculi. An X-Ray Crystallographic and Microradiographic Study. Curt Lagergren. *Acta radiol. Suppl.* 133, 1956. (Karolinska Institutet, Stockholm, Sweden)

Six hundred urinary calculi, of which 460 were obtained from the kidney and ureter and the remainder from the urinary bladder, were studied by means of x-ray diffraction and microradiography. The composition of the stones was determined by different types of Debye-Scherrer diffraction cameras and one Geiger-Müller diffractometer. The architecture was studied by microradiography, which gives a topographical roentgenogram as well as information on the distribu-

tion of the components, depending upon their varying absorption of the x-rays. The composition of these different components was further analyzed by an x-ray microdiffraction method.

Eleven crystalline components were identified in the 600 stones examined. Only four of these were found to be common, i.e., in excess of 30 per cent. They are calcium oxalate mono- and dihydrate (Whewellite and Weddellite), basic calcium phosphate (Apatite) and magnesium ammonium phosphate (Struvite). One, uric acid, was found in less than 10 per cent and four, calcium hydrogen phosphate dihydrate (Brushite), tricalcium phosphate (Whitlockite), ammonium hydrogen urate and cystine, proved to be very rare, occurring in less than 0.5 per cent of the stones.

The texture of different types of calculi as determined by microradiography is described in detail, and numerous excellent illustrations are presented. The significance of the topographical structure of stones with regard to known conditions for precipitation of the different crystalline constituents is discussed. It seems that very small alterations in the ionic set-up of the urine may cause precipitation of two different crystalline components.

A comparison of the analytical methods used in these studies with the common chemical analysis of stones demonstrates that the latter is not sufficiently accurate to distinguish between similar substances, such as the three calcium phosphates, which occur in calculi. A complete list of references concludes the presentation of these interesting studies.

Thirty-three illustrations. OTTO GLASSER, Ph.D.
Cleveland Clinic

TECHNIC

Motion in Cardiovascular Radiography. Charles T. Dotter. *Circulation* 12: 1034-1042, December 1955. (University of Oregon Medical School, Hospitals and Clinics, Portland 1, Ore.)

A new and promising approach to the problem of accurately recording fast moving structures is presented. It employs an electronic timing mechanism adaptable to conventional radiographic equipment which gives exposures measured in a few thousandths of a second. Detail is remarkably improved over ordinary technics, and the author believes that, as a result, the number of films required will be greatly decreased, reducing patient exposure and expense. An encouraging feature is the statement that the "switch-tube" is expected to have a long life and reasonable cost. The roentgenograms reproduced have a sharpness of detail that approaches that of injected post-mortem specimens.

Nine roentgenograms; 3 photographs; 1 drawing.
ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Advantages of High-Voltage Technic [for Radiography] and Its Physical Foundations. Paul Fries. *Radiol. med. (Milan)* 41: 1219-1233, December 1955. (In Italian) (Laboratory of the Siemens-Reiniger Werke, Erlangen, Germany)

The first part of this paper deals with theoretical considerations of high-voltage technic, giving the formulas which establish the relationship between contrast on a film and the various radiographic factors. The second part is devoted to practical considerations.

Since at about 125 kv the secondary radiation has al-

most the same hardness as the primary, the scatter is not absorbed by the body and has an untoward effect on the film. To get rid of this, one can use either a special grid or the technic of Groedel, with the film placed about 15 to 20 cm. from the patient in order to reduce the scatter by virtue of the inverse-square law.

Some advantages of the hard-ray technic are as follows: More structures are visualized on a single study by virtue of the lengthening of the contrast scale. This increase in exposure latitude reduces the technical errors so common with soft-ray technics. Milliamperes-seconds can be reduced, with the advantages of shorter exposure. Since the energy accumulating on the focal spot is inversely proportional to the fourth power of the tension on the tube, high-voltage radiography spares the tube. Procedures that demand rapid serirography are thus possible, even to fifty exposures a second in cineradiography. Also, very fine focal spots are made possible. Further, the patient receives less radiation.

The high-voltage technic produces exceptionally worthwhile results in the chest. Lung detail which would otherwise be hidden is clearly visualized through bony structures. Whereas the author was working in the range of 100 to 150 kv, he mentions work done in America (1953) with 1,000 kv, clearly demonstrating the larynx, trachea, principal bronchi, and the beginnings of the lobar bronchi.

Thirteen illustrations.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Some Experiments on the Perception of Images of High Contrast with an Image Intensifier, a Levy-West Screen and Radiographs. F. R. Berridge and Muriel Guest. *Brit. J. Radiol.* 28: 688-692, December 1955. (United Cambridge Hospitals, Cambridge, England)

The authors performed experiments to test the visibility and resolution of small objects on a fluoroscopic screen (Levy-West "Sirius" H. D., using a fine Schenck stationary grid) and an image intensifier screen (Philips). The test objects were viewed in a phantom consisting of a Perspex tank filled to various specified levels with water. To test for detection of objects, silver wires varying in diameter from 0.08 to 1 mm. were imbedded in Perspex cylinders (whose radiopacity is very similar to that of water, so that the cylinders themselves were not visible in the tests). For the identification of test objects, copper wires were arranged in various shapes, either 1 cm. or 0.5 cm. in height.

For determining detectability, the silver wires were tested ten times in different positions in the phantom, and ten control observations were made without the presence of the test object. Only if the observer was correct in all twenty experiments was the particular wire considered visible. Preparation for use of the fluoroscopic screen consisted in wearing dark red adaptation goggles for fifteen minutes. With the image intensifier the room was illuminated by a 40-watt light 12 feet to the right of the observer, who used no dark adaptation procedure.

Smaller objects were identified with the image intensifier than with the fluoroscopic screen, the latter requiring about twice as great a diameter as the former for visualization. With both methods the smallest visible size varied with the thickness of the phantom. In the use of the image intensifier, increase of voltage from 75 to 85 kvp, raising the current from 1 to 2 ma, or complete darkening of the room made no difference in

the accuracy of detection, although these maneuvers did reduce the fatigue of the examiner.

In the identification of copper wires of various shapes the image intensifier again was found to offer a considerable advantage over the fluoroscopic screen.

Radiographs were found to be superior to the fluoroscopic screen and the image intensifier as regards both detection and identification of the test objects. In using the thickest phantoms, however, the smallest sizes of silver wire were extremely difficult to detect, because of the lower contrast in these phantoms.

In applying their results to barium studies on patients, the authors point out that with the image intensifier almost all of the mucosal detail which can be shown on radiographs can be seen, provided that barium-filled crevices are viewed edgeways. Thin coatings of barium suspension seen *en face* are not readily visible with the image intensifier.

Two photographs; 2 tables.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

MISCELLANEOUS

Radiological Diagnosis of Retained Surgical Sponges.

Herbert M. Olinick, H. Stephen Weens, and James V. Rogers, Jr. *J.A.M.A.* 159: 1525-1527, Dec. 17, 1955. (H. M. O., 724 Hemlock St., Macon, Ga.)

The radiologist should be on the alert for a retained sponge in any patient with an unexplained postoperative mass, sinus tract, or intestinal obstruction. In recent years sponges and laparotomy packs have been made with radiopaque filament or ribbon type inserts. There are still patients, however, who were explored some years ago, in whom the retention of a sponge or pack is responsible for the signs noted above. Pathologically there is either an aseptic fibrinous reaction with an attempt at encapsulation or an exudative reaction with abscess formation.

Radiographically the opaque inserts should be demonstrable despite the fact that the sponge may be distorted by folding, twisting, and disintegration. Gas, originating from the intestine or from bacteria within the sponge-containing abscess, may give a whorl-like pattern. Often the foreign body will become encapsulated and present as a movable mass if in the mesentery or as an immobile mass if fixed to the parietal peritoneum. Rarely, calcification may occur; this is more likely when the mass is in contact with the lumen of the intestinal or urinary tract but is occasionally seen when it lies free within the peritoneum.

When a sinus tract has developed, injection of a radio-opaque oil will outline the pocket of the tract as well as delineate the meshwork of fibers in the sponge. If the foreign body ruptures into the lumen of the bowel, a bizarre pattern will be noted following a barium meal.

Four roentgenograms. SAUL SCHEFF, M.D.
Boston, Mass.

Torulosia. Cyril Fortune, Gordon Donnan, John Colebatch, and Thies Lubbe. *M. J. Australia* 2: 199-204, Aug. 6, 1955. (Perth, Australia)

The history and pathogenesis of torulosis is discussed and 2 cases are presented. The disease not infrequently mimics Hodgkin's disease.

In the authors' first patient roentgen examination revealed an opaque area in the right lower lung field compatible with benign tumor, diaphragmatic hernia,

or intrathoracic extension of liver abscess. There was no displacement of interlobar fissures or hilar adenopathy. Lobectomy was done, and a soft jelly-like mass was found. Grossly this suggested a bronchial adenoma, but microscopic studies revealed *Cryptococcus neoformans* (*Torula histolytica*).

The second patient exhibited radiologic evidence of low-grade osteitis of the left tibia compatible with brucellosis. This was supported by agglutination tests. At necropsy, *Torula* was not demonstrated in the tibia, and it was thought that x-ray therapy to the area may have had something to do with this. Orbital views disclosed a radiolucent mass without bone destruction on either side. Recurrence followed each surgical ef-

fort at removal. There was lacrimal gland involvement (hitherto unreported). The orbital masses showed calcification. Terminally, complete opacity of the antrum and the frontal, ethmoid, and sphenoid sinuses on the left was noted. Necropsy revealed the sinuses to be invaded by gelatinous granulation tissue. No radiographic evidence of pulmonary involvement was noted. The diagnosis was based on the finding of cryptococci in the meninges and brain.

Both patients died soon after onset of neurologic symptoms. There is no effective treatment.

Eight roentgenograms; 3 photomicrographs; 2 photographs; 1 table. J. E. CARLISLE, M.D.

Shreveport, La.

RADIOTHERAPY

The Role of Radiotherapy in the Treatment of Malignant Disease. Ralston Paterson. South African M. J. 29: 1215-1219, Dec. 24, 1955. (Christie Hospital and Holt Radium Institute, Manchester, England)

The author states it as his purpose to try and set out in orderly fashion the contributions which modern radiotherapy "...can make to the control of malignant disease." While he presents nothing new, he does outline with great clarity the applications of irradiation to the treatment of cancer. The following scheme of presentation indicates the scope of the paper:

Palliation

Curative Functions

Malignant diseases previously uncontrolled, as tumors of the nasopharynx, seminoma of the testis, medulloblastoma, Wilms' tumor

As an adjunct to surgery, as in breast cancer

Radiotherapy curative in its own right: cancer of the skin, mouth, and lip, cervix uteri, and bladder

Finally figures are presented to show the growth of radiotherapy in Great Britain between 1938 and 1954. It is, to use the author's word, "impressive."

Malignant Melanoma. Bertel Jørgsholm and Inger Engdahl. Acta radiol. 44: 417-433, November 1955.

The authors have analyzed a series of 219 cases of malignant melanoma, some of which were treated by surgery, some by radiotherapy, some by a combination of surgery and radiotherapy. The majority occurred at the usual cancer age. The youngest patient was a three-year-old girl, and the oldest a ninety-four-year-old man. There was no prepubertal patient among the 78 males. All cases were staged according to the following plan when first seen:

Stage I: Localized tumor or local recurrence of tumor without demonstrable lymph node involvement.

Stage II: Localized tumor and a few enlarged nodes in one regional group, clinically operable.

Stage III: Involvement of several lymph node groups and/or distant metastases.

The percentage of patients in Stage I was 61; Stage II, 21; Stage III, 18. Microscopic verification of the diagnosis was available in 201 cases, or 91.8 per cent. Preformed nevi were present in 42 per cent. Previous trauma was reported by 62 patients (27 per cent). Furthermore, 40 patients had been traumatized by inadequate treatment. The sites of relative predominance were the head, neck, and soles.

The therapeutic methods changed during the period represented by the series. Radium and x-rays were used earlier; later the main principle has been primary surgical excision, sometimes combined with or followed by dissection of the lymph nodes. Radium and x-rays still are used as palliative agents.

The overall five-year results show 28.8 per cent of the patients living free of symptoms. For Stage I cases this figure is 43.6 per cent, and for Stage II 10.6 per cent. There were no five-year survivors in Stage III. The five-year results for males and females with Stage I lesions differed strikingly: the five-year cure rate for females was 51.1 per cent; for males 27.1 per cent.

Five-year results are also analyzed according to treatment. Of 52 patients treated by surgery alone (Stage I), 26 were living and free of symptoms at the end of five years. Of 15 Stage I patients given radiotherapy alone, 9 were living and free of symptoms at the end of five years. In only 2 of the patients well for five years did recurrence or metastases develop at a later date. Lymph node dissection apparently saved 9 out of 86 patients.

The authors state that at our present stage of knowledge any nevus showing signs of proliferation, i.e., growth in circumference or height, ulceration, bleeding, or increased pigmentation, should be considered a potentially malignant tumor and should be treated as such.

The treatment of choice is surgery: (1) wide, local excision in three dimensions; (2) block excision of the primary tumor and regional lymph nodes in continuity; (3) excision of the primary tumor and regional lymph nodes; (4) amputation. Radiotherapy is justified in some cases.

Two figures; 1 diagram; 7 tables.

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Indiana University Medical Center

Radiation Therapy Viewed by the Otolaryngologist.

James E. Coyle. Ann. Otol., Rhin. & Laryng. 64: 1095-1108, December 1955. (573 Fisher Bldg., Detroit 2, Mich.)

This paper reviews the more important fundamental principles of radiation therapy, with some mention of the older and more conventional types in comparison with the newer modalities, and describes the present treatment of head and neck cancer.

After a brief discussion of biologic radiosensitivity and radiation principles, the author discusses in a general way the various forms of irradiation: roentgen therapy

in the supervoltage and ultra-high voltage ranges, radium, and radioactive isotopes.

Rotation therapy is usually thought of as a function of supervoltage therapy. Its advantages are greater depth dose, less radiation reaction, better distribution in the tumor, and diminished skin reaction. Its application, however, is limited to a few deep-seated radiosensitive tumors. Grid therapy also is considered to have little usefulness in cancer of the head and neck (except for carcinoma in the distal third of the esophagus) because of lack of homogeneous distribution and excessive damage to adjacent normal structures.

The cyclotron and betatron offer ultra-high voltage. The cyclotron has not been of value in cancer therapy but the betatron has proved to be useful.

Radium has been employed in the treatment of neoplasms since its discovery and will continue to be used in view of the wealth of experience gained by radiotherapists, its clinical effectiveness in certain lesions, and its present availability in most institutions.

The research into the production and use of radioisotopes has been enormous but to say that they have revolutionized or altered the treatment of cancer would be untrue. Their biological advantage is *quantitative*, rather than qualitative, in comparison to conventional x-ray therapy. No change has been noted in the inherent vulnerability, or lack of it, of cells to radiation. Thus the radiosensitivity of a tumor has not been altered by supervoltage radiation or radioisotopes. Secondly, it has not been possible to deposit a radioisotope selectively into tumor tissue without affecting normal structures. As yet, research has not identified a single substance, or groups of substances, common to malignant lesions which might be affected by the radioactive compounds. The most important use of radioactive isotopes to date has been the pursuit of knowledge of fundamental biological, biochemical and physiological processes.

Two tables.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

The Treatment of Carcinoma of the Larynx. Arnold Grossman. Ann. Otol., Rhin. & Laryng. 64: 1067-1075, December 1955. (Montreal General Hospital, Montreal, Canada)

In order to evaluate five-year results in laryngeal cancer, the author offers the following classification: (1) intrinsic; (2) endolaryngeal extrinsic; (3) extrinsic.

An *intrinsic* lesion is one that is localized to the middle or anterior third of the true vocal cord. The cord must be movable and there must be no metastases. Lesions localized to the tip of the epiglottis may be included in this group on the basis of their favorable prognosis.

Tumors of the *endolaryngeal extrinsic* group are "extrinsic" to the anterior two-thirds of the vocal cord but "endolaryngeal" in that they are still confined within the laryngeal voice box without spill-over beyond its borders or metastases in the regional or peripheral nodes. Included in this group are cases with fixation of the vocal cord, suggesting invasion of the intrinsic laryngeal muscles, and lesions involving the posterior third of the true cord.

Extrinsic lesions are those which would fall in Groups 1 and 2, except that they have metastasized, lesions that have spilled over beyond the borders of the larynx into the base of the tongue, the valleculae, the pyriform

fossa, or the postericoid area, and those which have extended forward through the cricothyroid membrane into the neck.

For the *intrinsic* tumors, surgery is the treatment of choice. For patients treated by deep x-ray irradiation because of medical restrictions or other reasons, the five-year survival rate is much lower than that obtained with laryngofissure. Tumors involving the epiglottic tip respond well to removal by endoscopy plus fulguration, deep roentgen therapy, and radon seed implantation.

The *extrinsic endolaryngeal* cases do best with laryngectomy. Deep x-ray therapy has been tried for these lesions, but the results have not been as good as with surgery.

The outlook for patients with extrinsic cancer is quite bleak; they rarely survive, regardless of the form of treatment. If a 10 per cent five-year survival rate can be achieved by x-ray therapy, it is as much as can be expected.

Recently some attempt has been made to improve the results for Group 2 and Group 3 cases by performance of a one-stage laryngectomy and prophylactic radical neck dissection. The final word regarding this approach has not yet been written. It is believed that a two-stage procedure would be of definite value, especially in older patients and in those whose physical condition may prevent extensive radical neck surgery in one stage. In Group 3 cases, where neck nodes are palpable and fixed, x-ray therapy locally and to the neck, along with the introduction of radon seeds into the nodes, is of some value from the standpoint of palliation.

The otolaryngologist must determine what precise form of treatment or combination of treatments would best suit the specific case. He must choose judiciously from among the following methods of treatment, to obtain the best results: laryngofissure; laryngectomy; endolaryngeal excision with or without electrofulguration and deep x-ray therapy; tracheotomy, either palliative or as a preliminary to further curative therapy; radical neck dissection, prophylactic or otherwise, in a one-stage procedure combined with laryngectomy or as a second-stage operation; deep x-ray therapy to the larynx, with or without removal of one or both thyroid alae; deep x-ray therapy to cervical neck nodes, prophylactically, curatively or palliatively; radon seeds.

A case is reported in which the entire right true vocal cord and the anterior commissure were involved by a Grade 3 epidermoid carcinoma. The patient survived five recurrences and was well after eight years. This example illustrates the value of judiciously combined surgery and irradiation.

One roentgenogram; 1 chart.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

Treatment of Cancer of the Lung. Alfredo Cesanelli. Radiología 6: 25-29, December 1955. (In Spanish) (Rosario, Argentina.)

The author states that, despite recent technical advances, radiation therapy cannot achieve lasting results in bronchogenic carcinoma. Nitrogen mustard at times alleviates distressing symptoms but never delays the fatal issue. When feasible, surgery gives the best chance of survival.

Four hundred and sixty-eight patients with "pulmonary cancer" were seen between 1943 and 1952. In 102 of these, considered surgical cases, exploration was

done, with resection in 54 (3 lobectomies, 51 pneumonectomies). Only 6 of the 102 patients were asymptomatic at the time of discovery, and resection was possible in all of these, which emphasizes the importance of early diagnosis. Following resection there were 16 surgical deaths, 22 delayed deaths (one patient died three years after surgery, without evidence of cancer), and 16 survivals (3 over five years, 3 over two years, 5 over one year, 4 less than one year).

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Carcinoma Cervix Uteri—Treatment Priorities. Ralston Paterson. South African M. J. 29: 1228-1231, Dec. 24, 1955. (Christie Hospital and Holt Radium Institute, Manchester, England)

The author attributes the improved cure rate in carcinoma of the cervix to four factors: (1) the greater consciousness of the public, in many countries, of the vital importance of early treatment; (2) new methods of early diagnosis; (3) improvement in treatment, particularly in respect to dosage calculation; (4) elimination of the risks of treatment. Each of these he discusses. Tables based on Heyman's reports are included.

Reappearance of a Cervical Carcinoma Thirty Years after Treatment with Radium. John Howkins and James D. Andrew. J. Obst. & Gynaec. Brit. Emp. 62: 870-871, December 1955.

A case is reported in which an active carcinoma of the cervix reappeared nearly thirty years after irradiation. The patient was first seen in 1925, at the age of thirty-eight, with a history of intermittent blood-stained discharge for two weeks. A cervical biopsy was taken, but unfortunately the original slide was no longer available at the time of the present study. A vaginal application of 38 mg. of radium was made, 1.5-mg., 2-mg., and 5-mg. needles being distributed in and around the portio vaginalis and left in place for one hundred and forty-four hours. A month later a further application of radium needles was made intra-abdominally. The abdomen was opened by a sub-umbilical mid-line incision; a rubber sponge shaped to fit the pouch of Douglas and carrying 18 radium needles in its lower pole was inserted behind the uterus, where it was sutured in position. The radium and its holder were removed twenty-four hours later.

The patient attended the follow-up clinic at yearly intervals for a period of fourteen years, during which there was no evidence of recurrence of the growth. She was again seen in 1954, over twenty-nine years after the original carcinoma was discovered, with a history of vaginal bleeding of three days duration. Examination revealed stenosis of the vaginal vault with marked atrophy of the cervix; a friable ulcer, 1 inch in diameter, was found eroding the cervix and infiltrating the vault. Biopsy confirmed the presence of a fairly well differentiated squamous-cell carcinoma. Further irradiation was thought inadvisable, and a Wertheim's hysterectomy was performed, with great technical difficulty.

The occurrence of cancer of the cervix nearly thirty years after a very adequate application of radium can be accounted for in three ways: first, that it is a true recurrence of the primary growth; second, that it is a new primary lesion appearing at or near the site of the original; third, that it is a delayed result of irradiation. Since the original slide was not available, no histologic

evidence could be adduced to support or refute any of these theories.

One photograph; 1 photomicrograph.

A Review of 306 Cases of Endometrial Carcinoma. Hilary B. Bourne, J. P. A. Latour, and Newell W. Philpott. Surg., Gynec. & Obst. 101: 753-758, December 1955. (Royal Victoria Montreal Maternity Hospital, Montreal, Canada)

Three hundred and six cases of endometrial uterine carcinoma were diagnosed at the Royal Victoria Montreal Maternity Hospital between 1926 and 1953. An attempt was made to analyze the survival rates on the basis of surgical or radiological treatment, although this was difficult because of variations in both operative and irradiation techniques. The absolute five-year survival rate for all the modalities was 59.3 per cent. This includes 6 patients who received no treatment because they were first seen in a terminal state and another 3 who are untraced and presumed to be dead. If these 9 are excluded, the survival rate was 62 per cent. Surgery constituted part or all of the treatment in 113 patients, of whom 69 per cent survived at least five years. Eighty-seven patients were treated by radiation alone, with a five-year survival of 52.9 per cent. Comparison between the methods is, however, probably unfair, since the advanced or inoperable cases were usually treated radiologically, influencing the statistics in favor of surgery.

Whenever surgery was employed either alone or with radiotherapy, the survival rate was higher than with irradiation only. Between 1926 and 1948, in approximately 200 patients, the relation of treatment to percentage of five-year survivals was: radiation only, 48 per cent; surgery only, 67.8 per cent; radiation plus surgery, 73.0 per cent, and surgery plus x-rays, 66.6 per cent. Although the best five-year survival rates resulted from the combined use of radium and surgery, the authors believe that surgical extirpation offers the best chance for permanent cure and they advocate it whenever possible.

When radium is employed, a minimal dose of 4,500 mg. hours is used if the uterus is small, and up to 7,000 mg. hours if it is large. Part of this radiation is directed to the cervix and vaginal vault by having a plaque placed against the portio of the cervix. If surgery is to follow the radium therapy, six weeks are allowed to elapse before operation. The authors have not yet administered vaginal radium to patients who have been treated primarily by total hysterectomy, as is done elsewhere in an effort to reduce recurrences in the most common site, the vaginal vault. Also, they feel that simple papanicolaou will probably give place to some form of radical hysterectomy combined with lymphadenectomy.

Five tables. MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

The Treatment of Endometrial Carcinoma by Means of Repeated Applications of Intracavitary Radium. William J. Dieckmann, Charles P. McCartney, and J. W. J. Carpender. Am. J. Obst. & Gynec. 70: 1258-1270, December 1955. (University of Chicago School of Medicine, Chicago, Ill.)

Thirteen women with endometrial carcinoma were treated solely by repeated applications of intracavitary radium. The medical status of these patients precluded major surgery and they were unacceptable to the roent-

genologist for deep x-ray therapy on account of obesity or because they had previously been treated by x-rays for benign conditions. The uncorrected and corrected five-year survival rates were 67 and 75 per cent, respectively.

Originally a central tandem and two lateral capsules were used. Later this mode of application was replaced by Heyman's technic of packing the uterine cavity with multiple small capsules (see Heyman: Brit. J. Radiol. 20: 85, 1947. Abst. in Radiology 50: 140, 1948). A total of 45 to 105 mg. of radium was used and the initial dosage varied from 3,500 to 5,000 mg. hr. A vaginal plaque was not employed, but a dummy was placed in the cervical canal to insure patency. The uterus was recurretated at intervals from one to thirty months following the initial therapy. In 11 instances there was persistent carcinoma. All 13 patients received a second application of 1,200 to 3,000 mg. hr. A second recurrettement revealed disease in 7 cases, and in these an additional 810 to 1,600 mg. hr. were given. In 5 a third curettage was done, revealing persistent disease in 2. The total dose in the 13 individuals ranged from 5,490 to 9,200 mg. hr. Only minor bowel distress was experienced by 3 patients.

The series included 3 adenoacanthomas, 3 well differentiated, 4 intermediate-grade, and 3 poorly differentiated adenocarcinomas.

Nine of the 13 patients were still alive at the time of the report, and in 8 there was no evidence of cancer. One had received a third application of radium and was clinically well. Two women died of cancer after four years: 1 had an adenoacanthoma with an adnexal mass at institution of therapy, and the other a poorly differentiated adenocarcinoma that metastasized to the vagina. Two patients, after three and eight years, died of cardiovascular disease and presented no evidence of carcinoma.

It was found that this method of therapy significantly increased the survival rate and that intracavitary radium in total amounts of 9,000 mg. hr., administered fractionally, could be employed. A standard dose of intracavitary radium will not destroy all the carcinoma cells if the uterus is large or the disease is extensive.

Two roentgenograms; 8 photomicrographs; 2 tables.
ROBERT L. EGAN, M.D.

University of Texas, Houston

Radiation Treatment of Subacute Thyroiditis.

Franco Fugazzola. Radiol. med. (Milan) 41: 1246-1254, December 1955. (In Italian) (Ospedale Civile di S. Croce, Cuneo, Italy)

This discussion of irradiation in thyroiditis excludes the acute suppurative forms and deals only with those subacute varieties which have a histologic picture dominated by giant cells and pseudotubercles, as described by DeQuervan in 1904. This disease occurs usually in the third, fourth, or fifth decade, especially in endemic goiter regions, and is about seven times as common in the female as in the male.

While the etiology is unknown, upper respiratory infections, a virus, and dental foci of infection have been suggested as possible factors.

The disease is characterized by a progressive painful swelling either of one lobe or of the whole gland. The onset is subacute or acute with pain radiating to the ears and shoulders. The skin is at times edematous and reddened. There may be dysphagia, respiratory

difficulties, and paralysis of the recurrent and cervical sympathetic nerves on the involved side. Fever is constant, but of varying intensity. Constitutional signs, such as asthenia, weight loss, etc., are present. The subsequent course is variable. The condition in one lobe may improve, with subsequent involvement of the other, either immediately or at a later date. The disease usually lasts from several days to several weeks, though it can persist for a year.

Conditions to be differentiated are: (1) suppurative thyroiditis, (2) tuberculosis, (3) thyroiditis of Riedel and Hashimoto.

A number of cases are presented and, on the basis of these and reports in the literature, the author considers irradiation to be the treatment of choice. He uses an "anti-inflammatory" technic. For the more acute forms the first two doses are 50 r, followed by 100 r every other day to a total of 1,000 r (170 kv, 0.5 mm. Cu plus 1.0 mm. Al filtration, 30 cm. focal-skin distance). The subacute form is similarly treated, but with 100 r for the first treatment and 150 r thereafter. In the chronic variety, 200 r are given daily, to alternate sides, for a total of 1,100 r per lobe (180 kv).

The results are excellent. Pain and dysphagia disappear, with improvement in the general condition. While opinion is certainly not uniform as to the value of radiotherapy in Riedel's and Hashimoto's diseases, a trial is believed to be worthwhile.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

The Unit of X-Ray Dose and Its Realisation. I. The Standardisation of X-Ray Dosimeters.

E. E. Smith. Brit. J. Radiol. 28: 662-669, December 1955. (Downs Hospital, Sutton, Surrey, England)

II. The Patient and the Röntgen. Part I. M. Cohen. Part II. Geoffrey Boden. Ibid., pp. 669-682. (The London Hospital, Whitechapel, London, E., England)

III. Practical Implications of the 1953 Recommendations of the International Commission on Radiological Units. J. E. Roberts. Ibid., pp. 682-687. (Middlesex Hospital, London, W., England)

Part I of this Symposium read at the Annual Congress of the British Institute of Radiology is concerned with primary standards for dosimetry and their calibration. Previous comparisons between the standard free-air chamber of the National Physical Laboratory in England and the primary standard of the National Bureau of Standards in the United States were found in 1953 to be in error. New chambers put into service in each of these laboratories indicated that the old N.P.L. "roentgen" was too large, by about 3.5 per cent at 80 kv and 7 per cent at 200 kv. Consequently clinical doses administered prior to 1953 consisted of more true roentgens than was realized from the use of dosimeters calibrated according to the N.P.L. standard.

Changes in sensitivity of Victoreen r-meters calibrated at different times have accounted for further errors of approximately equal degree in dosimetry. This lends emphasis to the manufacturers' recommendation that such secondary standard instruments be recalibrated at least once a year. At the present, checks are made chiefly against known quantities of radium or Co⁶⁰, or other radioactive isotopes such as Sr⁹⁰.

A description of the new N.P.L. free-air chamber, which will ultimately become the British free-air standard, is included. This has been found to agree to

within 0.5 per cent with the standard chamber of the N.B.S. over a range of 60 to 250 kv with moderate filtration. The sources of error in free-air chambers are discussed in some detail, and it is concluded that an absolute accuracy of better than 1 per cent is difficult to achieve in the conventional therapy region.

Dosimetry at high energies presents special problems, and possible courses for the standardization of dosimeters at energies up to 3 MEV are suggested.

Cavity chambers with walls of graphite or other appropriate air-like material appear to be accurate within 1 or 2 per cent in the measurement of rays generated by 2-MEV sources, and are much simpler to use than free-air devices.

Part II of the Symposium is in two sections by different authors. Cohen discusses the translation of measurements obtained in air from an x-ray source, first to a tank of water or equivalent homogeneous phantom, and then from the phantom to the patient. He describes the "surface dose-rate factor" as a ratio between the surface dose rate and the dose rate at 100 cm. in air with a standard applicator (as measured with a Victoreen chamber) and considers it a more useful concept in practical therapy than that of back-scatter factor because it obviates making measurements individually, for every condition of use, of the surface dose-rate in air at the face of every applicator.

Dosages in heterogeneous media complicate the measurement of radiation in parts like the thorax, where the lungs offer relatively little resistance to the passage of radiation. Cohen formed a thorax phantom of correct density and suitable atomic number by filling a container with a mixture of granulated cork and "Grape Nuts" breakfast cereal. In this phantom the dosage rates close to the surface were lower than those in a water phantom, but at depths greater than 5 to 7 cm. the dose-rates became considerably higher.

Boden, in his section of Part II, draws a distinction between the radiotherapeutic artist and the radiotherapeutic scientist. Because he believes that correct dosage in roentgens delivered to the tumor is of greater importance than the observable reaction of the tissues to radiation in the individual patient, he favors the approach of the scientist over that of the artist. In this connection he believes that depth doses should be corrected according to the type of tissue through which the beam passes, especially where lung and bone are concerned. He also issues a word of caution against giving very large doses with supervoltage radiation simply because skin reaction is not a limiting factor, and advises that with supervoltage radiation the maximum dose deep to any skin field should be less than that tolerable on the surface at ordinary kilovoltages.

Roberts, in Part III of the Symposium, discusses the problems to be faced in changing measurements of dosage from roentgens to rads, as has been recommended by the International Commission on Radiological Units in order to provide an expression of absorbed dose. He presents a graph showing the rad calibration of a particular Victoreen r-meter as measured in fat, muscle, average soft tissue in bone, and hard bone.

If the roentgen unit is eventually to be abandoned, it is still recognized that air ionization must for the present remain as the basis for practical dosimetry. While chemical methods may provide the answer for absolute energy absorption measurement, the complete change-over from roentgens to rads will be a comparatively slow

process. The author suggests that specifications of dosage should immediately be made in rads for β or γ -ray emitters, and with telecurie and high-voltage x-ray therapy above about 500 kv. For treatments given at potentials of less than 250 kv the conversion to rads is still difficult. The production of "isorad" curves for bone, lung, and other tissue will for the time being remain a highly individual problem in the handling of each patient, and a very tedious and time-consuming one.

One roentgenogram; 6 photographs; 2 drawings; 5 graphs; 8 tables. ARTHUR S. TUCKER, M.D. Cleveland Clinic

Physical Requirements of Beam Defining Systems for Medium Distance Teletherapy Units. J. L. Haybittle. *Acta radiol.* 44: 505-520, December 1955. (Addenbrooke's Hospital, Cambridge, England)

The physical requirements of beam-defining systems for teletherapy units working at source-skin distances from 20 to 40 cm. are discussed with special reference to sources of cesium 137 and cobalt 60. It is assumed that the penumbral width of the beam is limited to 1.25 cm. and that the integral dose does not exceed that given by x-rays of h.v.l. 1.5 mm. Cu and focus-skin distance 50 cm. Cones designed to meet these requirements are examined theoretically and experimentally to determine the electron contamination of the beam at the skin. Values are given for the surface ionization ratio, defined as the ratio of the surface dose to the maximum dose at a depth where electronic equilibrium is attained. From the results given, the surface ionization ratio can be predicted for any actual teletherapy unit. It is further shown that extension cones should be avoided, since they increase the surface dose.

The influence of source size on the thickness of the shielding of applicators and diaphragms is also examined and discussed.

Eleven diagrams; 3 tables. T. H. ODDIE, D.Sc. Bowman Gray School of Medicine

The Proposed Brookhaven Medical Research Reactor. J. S. Robertson, E. Stickley, V. P. Bond, and L. E. Farr. *Nucleonics* 13: 64-68, December 1955.

This article considers a number of medical and research uses of reactor-produced neutrons, and describes a proposed medical research reactor of optimum design to meet these needs. On the basis of current research, proposed research, and treatment of patients, certain requirements are specified. With respect to the neutron capture therapy of patients with glioblastoma utilizing the $B^{10}(n,\alpha)$ reaction, an external beam with a thermal neutron flux of the order of 10^{11} neutrons per square cm./sec. over a 10-cm.-square port is necessary, in order to produce an adequate flux at the tumor depth in the short period of time during which preferential concentration of boron exists. For some studies the thermal neutron beam has to be as free as possible from fast neutrons and gamma rays, while for others the presence of external neutrons or the production of fast neutrons and gamma rays is desired. A facility for animal studies to test procedures for patient radiation is also necessary. In addition to these localized port requirements, a facility to permit whole-body irradiation of large animals with neutrons of various energies is needed.

After considerable research by the staff at the Brookhaven National Laboratory and the aid of commercial groups, a one megawatt swimming pool type reactor has been designed. Air-cooled graphite is specified as the moderator and reflector. The core itself is cooled with light water. A diagram illustrates the details of the proposed reactor. On one side, a port is designed specifically for patient therapy. It is intended to vary the neutron energy spectrum through this port from

thermal energies up to about 8 kev by varying the moderator material. An identical facility is provided on the opposite side of the reactor for animal experimentation. On another face a broad-beam facility is designed for total-body irradiation, and provision is also made for isotope activation and the irradiation of small objects.

Two figures.

JOHN S. LAUGHLIN, Ph.D.
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RADIOISOTOPES

Radioiodine Treatment of Euthyroid Cardiac Disease. Four Years Experience with Two Hundred Thirty-One Patients. Henry L. Jaffe, Maurice H. Rosenfeld, Frederick W. Pobirs, and Laurence J. Stuppy. *J.A.M.A.* 159: 434-439, Oct. 1, 1955. (Cedars of Lebanon Hospital, Los Angeles 29, Calif.)

The authors review previous reports and add their own observations on the radioiodine treatment of euthyroid cardiac disease. This therapy is solely symptomatic, the benefits being derived from the production of a relative hypothyroidism, thus lowering the total metabolism and reducing the work burden on the heart. The series reported included 231 patients with severe angina pectoris or severe congestive heart failure or both; a few suffered from paroxysmal acute pulmonary edema. As a preliminary to the actual treatment a tracer dose of $5\mu\text{c}$ was given, followed by administration of $500\mu\text{c}$, after which a "thyrogram" was obtained by a scintillation counter as a base line for future studies.

A series of divided doses of radioiodine is given consisting of 6 millicuries per week for a total of 30 millicuries. This may be repeated after an interval unless signs of hypothyroidism develop. The authors advocate this small-dose method of administration, as they feel that it prevents serious side-effects often encountered when larger single doses are employed. In addition, a total hypothyroid state was thus avoided, this being considered undesirable. Results as analyzed have been considered good for the duration of the patients' lives. The figures are as follows: Patients with angina pectoris (94 in number) showed 56 per cent excellent and 37 per cent good results. Only 7 per cent showed no improvement. Patients with congestive failure (78 in all) showed 53 per cent excellent and 28 per cent good results; 19 per cent showed no improvement. A group of 59 patients with angina pectoris and congestive heart failure combined showed 48 per cent excellent and 32 per cent good results; 20 per cent showed no improvement. No evidence was observed that the treatment with radioiodine shortened the life of these patients nor did it apparently influence the development of atherosclerosis.

Three thyrograms; 3 tables.

ARTHUR S. SHUFRO, M.D.
University of Michigan

Severe Euthyroid Cardiac Disease. Technique for Treatment with Radioiodine. Henry L. Jaffe. *California Med.* 83: 412-415, December 1955. (Cedars of Lebanon Hospital, Los Angeles 29, Calif.)

Report is made on 278 euthyroid patients with severe cardiac disease treated by radioactive iodine. The author uses a multiple small-dose technic. Before

treatment is undertaken, the patient receives a careful medical evaluation, the thyroid uptake of I^{131} is determined by an oral tracer dose, and a scintigram is obtained. Radioiodine is then given in 6 mc doses at weekly intervals until a total of 30 mc has been given. After a wait of thirty days the scintigram is repeated and if the thyroid is still functioning relatively normally, another series of five weekly doses of 6 mc is given. A month later a third scintigram study is made and, if indicated, treatment is repeated.

The multiple small-dose technic is believed to have the following advantages over the single massive dose technic: (1) no danger of production of temporary hyperthyroidism with its deleterious effect, (2) no radiation thyroiditis, (3) no important bone marrow depression, (4) less radiation hazard than is created by the patient who has taken a single massive dose. The radiobiological time factor for production of the desired effect seems not to differ significantly from that with a massive single dose.

No greater degree of hypothyroidism should be permitted than is adequate to gain clinical relief from cardiac symptoms. It is pointed out that patients must be followed carefully after radioactive iodine treatment to detect evidence of myxedema as early as possible, so that they may be adequately controlled with small individual doses of desiccated thyroid substance.

In the series reported, the author claims 35 per cent excellent results and 44 per cent good results. In only about 21 per cent was no improvement achieved. The series included 127 patients with angina pectoris, 86 with congestive failure, and 65 with both conditions.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Treatment of Toxic Adenomatous Goiter by Large Doses of Radioactive Iodine. James R. Cook, Robert W. Jones, and E. Perry McCullagh. *J. Clin. Endocrinol. & Metab.* 15: 1512-1517, December 1955. (J. R. C., 1219 Shady Lane Drive, Orlando, Fla.)

Surgery is the first choice in the treatment of toxic adenomatous goiter, but in cases where the patient refuses surgery or because his physical condition makes him a poor surgical risk, radioactive iodine should be given first consideration. The antithyroid drugs, such as propylthiouracil, have the disadvantage of requiring many months of therapy before the hyperthyroidism is controlled.

The authors present the results obtained in 31 patients treated with a large initial dose of radioactive iodine. In 23 the hyperthyroidism was relieved within four months. Following an initial dose of 50 millicuries or more, the hyperthyroidism appeared to be controlled more promptly and more effectively than following a

smaller initial dose or smaller repeated dose. In no instance was the cardiac status aggravated by treatment. In some patients, initial therapy did not control the hyperthyroidism, but further treatment with radioactive iodine resulted in a euthyroid condition. In others the thyroidal uptake of radioactive iodine was too low, despite persistent thyrotoxicosis, to warrant repeated administration.

Three tables. THEODORE E. KEATS, M.D.
University of Missouri

Supervoltage Radiation Therapy; The University of Louisville-Louisville General Hospital Cobalt 60 Unit. Herbert D. Kerman and J. T. Ling. J. Kentucky State M. A. 53: 1061-1065, December 1955. (University of Louisville School of Medicine, Louisville, Ky.)

The authors review the advantages of supervoltage radiation therapy, which are, in brief, a possible very slight improvement in cure rates in radiocurable tumors, since more effective irradiation can be given than with conventional equipment; lessened radiation morbidity; decrease in dosage to normal tissues.

The cobalt unit recently installed in the Louisville General Hospital is described. A cobalt-60 beam in comparison with a heavily filtered 200-kv deep x-ray beam gives a significant increase in depth dose of approximately 20 per cent with the same field area and focus-skin distance.

Nine illustrations.

The Use of Radioactive Cobalt in Nylon Sutures in the Treatment of Bladder Tumors: Technique and Case Reports. Vincent Vermooten and J. G. S. Maxfield. J. Urol. 74: 767-776, December 1955. (V. V., 2609 Welborn St., Dallas 4, Texas)

The authors believe the treatment of choice for infiltrating carcinomas of the urinary bladder wall to be radiotherapy with radioactive cobalt in nylon tube sutures. Papillomas, particularly when multiple, and small easily attacked surface cancers of the bladder should not be treated by this method.

The lesion is exposed through a suprapubic cystotomy. Thick layers of tumor tissue are "shaved down" by the use of a high-frequency cutting cautery until the bladder wall thickness is less than 1 cm. Long nylon leaders are then sewed through the tumor and a section of adjacent normal bladder wall in parallel lines 1 cm. apart. Proper placement of the nylon leaders is verified and adjustments are made before the radioactive cobalt sources are drawn from their protective safe into position. A 30-c.c. inflatable bag catheter is placed in the bladder via the urethra. The bladder wall and the abdomen are closed, and the long leaders are brought out on each side of the skin incision by separate punctures. Each of the radioactive source tubes may then be individually identified and adjusted. The bulb catheter is inflated with air to separate the bladder walls and cut down the dose to adjacent normal tissues. Stereoscopic anteroposterior and lateral radiographs are made for study of the distribution of the radioactive sources. Some control over the position of the cobalt can be exercised by traction on the protruding nylon leaders. Increased or decreased spacing between the parallel rows can be effected to some degree by inflation or deflation of the indwelling catheter bag, provided the bladder wall is not too much stiffened by tumor infiltration.

The radioactive sources are apparently assembled at the authors' institution. They consist of thin nylon tubes in which have been placed 3 mm. lengths of radioactive cobalt alternating with aluminum spacers of similar length. The number of individual sources is determined by the width of the tumor to be treated. Dosage calculation is based on the standard Paterson-Parker planar implant tables. The authors aim at a planar dose of 7,000 gamma roentgens delivered in about seven days. The radioactive sources are removed by traction on the protruding nylon leaders.

The authors treated 10 cases by this procedure, with early favorable results in 7. Three cases are presented in some detail. Some of these cases have been reported previously (see J. Urol. 74: 85, 1955. Abst. in Radiology 66: 805, 1956).

Six roentgenograms; 3 photographs; 2 drawings. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Colloidal As⁷⁵S₈. Its Production and Possible Use in the Treatment of Papillomatosis of the Urinary Bladder. Gunnar Walinder. Acta radiol. 44: 521-526, December 1955. (Radiumhemmet, Stockholm, Sweden)

For superficial papillomas of the urinary bladder, it is felt that a beta method of irradiation might prove to be adequate and involve less risk of fibrosis. Gold 198 has been used in this manner but the beta energy is rather soft, with a half-value layer in soft tissues of only about 0.4 mm. Yttrium 90 has also been used, but it is difficult to keep therapeutic activities in stable solution of this element, and the insertion of a non-colloidal solution into the urinary bladder may involve a larger risk of resorption.

In searching for some other isotope suitable for this purpose, the author's attention was directed to As⁷⁵, which has an average energy of 1.17 MEV beta radiation and a half life of 26.8 hours and is easily prepared as colloidal As₂S₃.

The author describes in detail the preparation of this colloidal solution, indicating that it is very important to keep the urinary pH value between 5 and 8 to avoid precipitation of the colloid; however, if precipitation of the colloid does occur, it is quite reversible following the injection into the urinary bladder of a suitable physiologic sodium chloride solution.

The method of dose calculation is outlined.
One photograph. I. MESCHAN, M.D.
Bowman Gray School of Medicine

Scintillator Grid Localizes Gamma Emitters Photographically. C. Kellershohn and P. Pellerin. Nucleonics 13: 34-37, December 1955.

This article describes in detail the development and design of a photographic method of recording the localization of radioactive isotopes in the body. The particular application employed here is to radioactive iodine in the Thyroid. The method developed involves the use of a lead collimating grid, scintillation crystals, and photographic film. The film is sandwiched between two lead sheets in which the collimating holes are drilled. In each of these holes sodium iodide crystals are placed near the film. The lead holes discriminate against scattered gamma rays and the crystals intensify the photographic detection of the transmitted gamma rays. Details are given of the considerations involved

in the design of the collimator, the choice of dimensions, and practical problems in the construction of the grid. Photographs are shown of distributions obtained with a mock thyroid and also with real thyroids.

Six figures.

JOHN S. LAUGHLIN, Ph.D.
Memorial Center, New York

Absorption of Radioactive Vitamin B₁₂ in Nonanemic Patients with Combined-System Disease. Irwin M. Arias, Leonard Apt, and Myron Polycove. New England J. Med. 253: 1005-1010, Dec. 8, 1955. (I. M. A., Boston City Hospital, Boston, Mass.)

Demyelination of the posterior and lateral columns of the spinal cord, known also as combined-system disease, posterolateral sclerosis, subacute combined degeneration of the spinal cord, and funicular degeneration, occurred in 80 per cent of cases of pernicious anemia before the advent of treatment of the latter disease with liver and vitamin B₁₂. This neurologic change usually follows the appearance of anemia but occasionally is seen first or even in the absence of anemia.

Suh and Merritt (Am. J. M. Sc. 196: 57, 1938) reported 8 cases of combined-system disease in non-anemic patients and regarded it as identical with that in anemia, and due to the same etiologic factors. Follow-up of these cases, however, seemed to indicate

that vitamin B₁₂ deficiency was not responsible for the neurologic changes.

Intrinsic-factor activity is essential to the adequate absorption of vitamin B₁₂ as it ordinarily occurs in food. In pernicious anemia, it is the absence of this intrinsic factor that results in deficiency of B₁₂ and the associated neurologic manifestations. The authors administered Co⁶⁰-labeled vitamin B₁₂ to 4 patients with combined-system disease without anemia to determine whether the cause of the neurologic disorder is the same as in the anemic group. Hepatic deposition of the labeled vitamin was measured with a scintillation counter and it was found that here, as in pernicious anemia, there was a lack of gastric intrinsic factor activity to account for the changes in the spinal cord.

Clinical states mimicking combined-system disease can occur as a result of involvement of the posterior and lateral columns of the spinal cord by pathologic processes of varied etiology. When the characteristic hematologic abnormalities of pernicious anemia are absent, the measurement of intrinsic-factor activity by the hepatic deposition of radioactive vitamin B₁₂ may serve to differentiate combined-system disease due to vitamin B₁₂ deficiency from this other group of diseases.

Four tables.

WILLIAM SNOW, M.D.
Shreveport, La.

RADIATION EFFECTS

Some Aspects of the Problem of Radionecrosis of the Jaws. W. Donald MacLennan. Proc. Roy. Soc. Med. 48: 1017-1022, December 1955.

Avascularity, necrosis, and infection symbolize the sequence of events in radio-osteomyelitis. The degree of involvement of soft tissues will determine whether infection precedes or follows the process of necrosis in the neighboring bone. In the treatment of malignant lesions about the oral cavity by irradiation, the sequence of changes has an added significance in that, if tumor cells are merely walled off by a barrier of fibrous tissue, these same cells can lead to a recurrence of the original lesion, should the barrier be broken by the ingress of infection.

In the radiograph, loss of definition of the bony cortex may be the only indication of early involvement of bone.

The teeth have always been acknowledged as an important problem with relationship to osteo-radionecrosis of the jaws. The author believes that teeth, healthy or otherwise, should be extracted and the sockets healed prior to exposure of the immediate local or surrounding tissues to radiation therapy.

When radionecrosis occurs, particularly in the mandible, pain is usually the main symptom. Except in the fulminating case no one factor contributes more to relief of pain than surgical removal of the necrotic tissues. The aim of surgery should be to: (a) create a defect by removing all the radionecrotic tissue; (b) encourage primary healing by closing the wound; (c) maintain the tissues as near to the anatomical position as possible until final reconstruction can be attained; (d) reduce infection to a minimum. The infection, which is invariably present, can usually be controlled in three ways: (a) improvement of the general condition of the patient, in part by an adequate diet of 3,500-4,000 calories daily, which may be attained by means of supplementary feedings by an intranasal polyethylene gas-

tric tube; (b) strict oral hygiene by mouth washes and irrigations with bland solutions such as bicarbonate of soda in distilled water; (c) antibiotic therapy.

In the presence of infection, full tumor doses of radiation are contraindicated, and surgery in the presence of radionecrotic tissues is far from satisfactory. It is therefore evident that it is vitally important to consider the relative merits of radiotherapy and surgery before embarking on treatment of lesions of the mandibular and maxillary region. Irrespective of the methods employed, two- to five-year cures of such lesions may be considered satisfactory from a purely scientific point of view, but there can be little doubt that if one considers the humanitarian aspects, such a life expectancy is far from satisfactory, especially if even that short span is marred by extremes of pain, disfigurement, and mental torture.

One table.

J. F. WEIGEN, M.D.
Palo Alto, Calif.

Observations on Roentgen Cancer. A. Beutel and F. Skopal. Strahlentherapie 98: 570-575, 1955. (In German) (Röntgeninstitut und der Strahlenklinik der Städt. Krankenanstalten Dortmund, Germany)

In Germany, the legal opinion has been expressed that the interval between radiation exposure and appearance of local carcinoma is always less than twenty years. The authors describe 7 cases in which carcinoma appeared six to thirty-three years after radiotherapy. In all, the treatment must have been intense, because extensive scarring or ulcerations were noted in the exposed areas. Carcinoma had spread beyond the treated area in some and formed metastases in 2. In many cases the legal issue is confused by chronic or recurrent infections, the use of tar ointments, improper management of radiodermatitis by other physicians, or by the patient's own volition, and poor hygiene.

Cases of other authors are cited which indicate a latent period of up to thirty-five years.

One photograph. GERHART S. SCHWARZ, M.D.
New York, N.Y.

The Management of Some Late Complications of Pelvic Irradiation. John J. Murphy. *J. Urol.* 74: 780-788, December 1955. (Hospital of the University of Pennsylvania, Philadelphia 4, Penna.)

Vesicovaginal fistula is one of the most common late complications of intensive pelvic irradiation and is frequently difficult to manage. The incidence is said to be 2 per cent in cases of carcinoma of the cervix so treated but to reach a much higher figure in diabetic patients (60 per cent). It now appears that temporary or permanent diversion of the urinary stream through an isolated ileal segment with ileostomy, as described by Bricker (*Surg., Gynec. & Obst.* 99: 462, 1954), is the most satisfactory method of management. The technic of this operation is described. The author then reports in moderate detail 6 of his own cases of vesicovaginal fistula, some complicated by rectovaginal fistula. All occurred secondary to pelvic irradiation for carcinoma of the cervix. An early good result was obtained in all.

Injury to the lower ureters by irradiation is said to occur in as many as 25 per cent of vigorously treated cases and hence is much more frequent than generally thought. Injuries in 5 per cent of these cases are said to be serious enough to require treatment. The author reports 1 case in which the lower third of the right ureter became stenotic. A length of ileum was substituted for the lower half of the stenosed right ureter with apparent good result. Patients managed by uretero-ileostomy appear to have little or no difficulty in maintaining a proper electrolyte balance. Pyelonephritis and other complicating infections are not usually encountered.

Fifteen roentgenograms; 2 drawings.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Late Effects (Twenty-five to Forty Years) of the Early Medical and Industrial Use of Radioactive Materials. Their Relation to the More Accurate Establishment of Maximum Permissible Amounts of Radioactive Elements in the Body. W. B. Looney. *J. Bone & Joint Surg.* 37-A: 1169-1187, December 1955; 38-A: 175-218, January 1956; 38-A: 392-406, April 1956. (U. S. Naval Hospital, Bethesda, Md.)

This three-part paper is a comprehensive review of the late effects of radioactive materials accumulated in the body, based upon observations of patients receiving radium salts for a variety of medical disorders between 1915 and 1930 and of watch dial painters using material containing radium, mesothorium, and radioactive thorium without adequate safety measures from 1915 to about 1927. The clinical changes in these persons developed fifteen to thirty years after the deposition of the radioactive substances in the body.

When first taken into the body, radium is considered to be dispersed throughout the soft tissues and the skeleton. Most of it is eliminated in the first week, chiefly in the feces. Within a month, 90 to 99.9 per cent has been lost. Elimination in the first week is from the soft tissues and gastrointestinal tract, during the remainder of the first year from the more accessible parts of the skeleton, and thereafter, at a decreasing rate, from the more inaccessible skeletal tissues.

The author describes the methods of determining the amount of retained radium and describes the autoradiographic technics used in studying the distribution of radium in the bone. The findings indicate that radium has more than one principal mode of deposition. Small highly concentrated areas of deposition occur at what may have been sites of bone formation at the time of administration or redistribution. The more uniform and less dense distribution may be the result of inorganic ion exchange.

The most important histopathological diagnostic changes are: (1) formation of atypical osseous tissue in the trabecular spaces of cancellous bone and (2) well differentiated areas of destruction in compact bone. Atypical osseous tissue was present in cancellous bone, usually near the articular surfaces as well as in the metaphyseal area. In some places this atypical osseous tissue was laid down adjacent to trabeculae. Hyperplasia and destruction of trabeculae were seen. The trabecular spaces were usually filled with an acellular fibrous tissue. The atypical osseous tissue and the acellular fibrous tissue areas usually showed an absence of radioactivity in the autoradiographic study. In most instances osteocytes were not present in the lacunae and there was little evidence of bone regeneration. In compact bone, the central canals showed a wide variation in size, from normal to nearly complete destruction of the entire haversian system. Minimal evidence of bone regeneration was observed. The areas of destruction were usually replaced by fibrous tissue.

The pathologic changes produced in the skeleton are probably the end-result of many intermediate factors, such as trauma, damage to blood supply, hormonal imbalance, decreased bone repair, and increased bone destruction from other causes. The relationship of radium deposition and skeletal change is complex. When the destructive effects of radium and other deleterious intermediate factors become greater than the reparative processes of the skeleton, permanent alterations occur.

In the second part of his treatise, the author describes 24 representative cases, in 7 of which malignant tumors developed. Observations on these and many other cases are exhaustively tabulated. They lead the author to the conclusions which follow:

Radiographically detectable skeletal changes are not seen until many years after the deposition of radioactive elements. Changes are of two types: increased density in cancellous bone due to trabecular hyperplasia and decreased density in compact bone resulting from destruction in the bony cortex. Areas of decreased density, depending on size or shape, may give bone a streaked appearance or a punched-out appearance. If these are intermingled with areas of increased density, the bone may have a mottled or moth-eaten appearance. This is seen especially in the femoral head, humeral head, glenoid process, and borders of the vertebral bodies. Aseptic necrosis with change in the normal configuration of bone is sometimes encountered in the femoral heads, mandible, and bones of the feet. Collapse of vertebral bodies is occasionally seen.

Oral changes occur frequently, and necrotic areas in the maxilla and mandible are the most commonly noted lesions in the skeleton. If destructive changes occur in the teeth, a reduction in density is seen, which gives them a pinkish hue. This finding may be considered almost diagnostic.

There may be periods during which skeletal changes

stabilize or improve. However, the usual picture is one of gradual increase in the number of areas and the number of bones involved.

Symptoms are usually due to destructive changes in the skeleton, and are not encountered in the absence of radiographic change. Neither symptoms nor x-ray changes are seen in patients having less than 0.5 micrograms of radium in the body. Ordinarily the symptoms are less severe than the amount of skeletal damage would lead one to expect. If large amounts of radium are ingested, the clinical course is rather like that of the acute radiation syndrome or acute leukemia.

In about 6 per cent of patients, malignant tumors eventually develop. There may be confusion in differentiation from more benign lesions such as osteoid osteoma, osteomyelitis and giant-cell tumor. Bones which bear weight or are subjected to repeated trauma appear to be favored sites for development of tumors.

In the final installment of his paper the author discusses the points made earlier and concludes that one or more destructive processes may act in conjunction with the deposited radioactive element to produce changes in the presence of much smaller amounts than if it were the sole etiologic agent. Proper evaluation of the different conditions which may be present with the deposited radioactive element, as well as the probability of their occurrence, is necessary for more flexible interpretation of maximum permissible body burdens. It is possible that the latter may be significantly elevated without increasing to a great degree the risk of difficulties if proper evaluation of other conditions which may act concomitantly is made.

This paper is illustrated with a large number of roentgenograms, photomicrographs, charts, and tables.

RICHARD P. STORRS, M.D.
Los Angeles, Calif.
DON E. MATTHIESSEN, M.D.
Phoenix, Ariz.

Iatogene and Occupational Radium and Thorium Diseases. A. Gebauer and R. Heinecker. *Strahlentherapie* 98: 558-569, 1955. (In German) (Medizinischen Universitätsklinik, Frankfurt/M., Germany)

Five patients received arterial Thorotrast injections for diagnostic purposes: 3 for cerebral angiography, 1 for demonstration of an aneurysm of the femoral artery, and 1 for demonstration of an aneurysm of the subclavian artery. One died fifteen years later of myelogenous leukemia, and 1 sixteen years later of cirrhosis of the liver and carcinoma of the rectum. Three are still alive, but 1 of these suffers from fatigue and porphyria thirteen years after injection; another complains of pain in the liver and spleen areas after eleven years and the third has dyspnea and retrosternal and bilateral lumbodorsal pain after eight years.

Dense Thorotrast deposits in the liver and spleen were demonstrable radiographically in all 5 cases. Common to all was severe upper abdominal colic for many years. No biliary or urinary calculi were seen in the two autopsied cases.

It has been estimated that an injection of 40 c.c. of Thorotrast delivers 300,000 r to the spleen and liver in seventeen years.

A sixth case, which was entirely different, is reported. A 48-year-old physical chemist worked in a radium and mesothorium plant from 1933 to 1947. Three other workers at this plant had died in 1930, 1935, and 1943 from radium intoxication. In 1948, the patient began

to suffer from cough and dyspnea. A gradually progressing pulmonary fibrosis led to death in 1953. Autopsy revealed chronic purulent bronchitis, bronchiectasis and pulmonary fibrosis. An analysis of the radium content of the organs was reported earlier by Muth and Roth (*Strahlentherapie* 80: 271, 1949). Severe pulmonary fibrosis was present in all 4 fatal cases from this plant. Radon could be detected in the expiratory air in all. The latent period between intoxication and symptoms ranges between three and twenty years.

Seven illustrations, including 2 roentgenograms.

GERHART S. SCHWARZ, M.D.
New York, N. Y.

Response of Human Beings Accidentally Exposed to Significant Fall-Out Radiation. Eugene P. Cronkite, Victor P. Bond, Robert A. Conard, N. Raphael Shulman, Richard S. Farr, Stanton H. Cohn, Charles L. Dunham, and L. Eugene Browning. *J.A.M.A.* 159: 430-434, Oct. 1, 1955. (Brookhaven National Laboratory, Upton, N. Y.)

The detonation of a thermonuclear device in the Marshall Islands in 1954 resulted in a radioactive fall-out which accidentally exposed certain Marshallese and Americans to whole-body gamma irradiation, beta irradiation to the skin, and minimal internal contamination. The highest exposure was received by a group of 64 Marshallese, whose whole-body dose was estimated at 175 r. It is upon this group that the present report is based.

In all cases the exposure was sublethal. There was a transient significant depression of hemopoiesis, but no clinical signs or symptoms developed that could be attributed with certainty to this effect. Skin lesions and epilation occurred in 90 per cent of the group on exposed parts of the body not protected by clothing. Varying degrees of protection were afforded those who remained indoors or bathed during the fall-out period. Treatment was palliative and preventive. Examinations one year after exposure revealed that these people were in general good health, though some depression of lymphocytes and platelets persisted.

Seven photographs; 1 photomicrograph; 2 charts.

ARTHUR S. SHUFRO, M.D.
University of Michigan

Radiation Exposure of Staff in Diagnostic Procedures. I. **Blood Counts—Research or Routine?** J. F. Loutit. *Brit. J. Radiol.* 28: 647-650, December 1955. (Atomic Energy Research Establishment, Harwell, England)

II. **Radiation Doses Received by Diagnostic X-Ray Workers.** S. B. Osborn. *Ibid.*, pp. 650-654. (University College Hospital, London, W.C. 1, England)

III. **Some Aspects of Radiation Hygiene.** W. Binks. *Ibid.*, pp. 654-661. (Radiological Protection Service, Ministry of Health and Medical Research Council, Sutton, Surrey, England)

This symposium, presented at the Annual Congress of the British Institute of Radiology in November 1954, consists of three separate papers.

Loutit (Part I) points out that, since the practice of performing blood counts on workers occupationally exposed to ionizing radiation was instituted, reliable physical methods of measurement of dose have been developed which are extremely sensitive and accurate. He believes that in many respects the physical measurements and the blood counts are complementary to

each other, but inclines to the verdict of Mole (*J. Clin. Path.* **7**: 267 1954) that physical methods should supplant, not supplement, the biological method. The evidence provided by the great majority of experimental workers points to no direct correlation between the values of total leukocytes or of any constituent of the leukocyte pattern with accumulated dose or dose-rate. A possible exception is the work of Helle and Wahlberg, who reported (*Acta radiol.* **40**: 435, 1953; **42**: 75, 1954) relative granulocytopenia, shift to the left, presence of hypersegmented neutrophil leukocytes, and presence of abnormal lymphocytes, but the author believes that these results, dependent as they are on subjective interpretation, are open to bias. He raises many questions which show the need for additional hematologic study and indicate that research is more likely than routine effort to be rewarding in blood studies.

Osborn (Part II), considering the dosage received by diagnostic workers, points out that primary x-ray beams are usually no hazard to personnel because they are fully intercepted. A greater hazard arises from scattered radiation. His review of studies published regarding doses received in the vicinity of x-ray machines indicates that diagnostic workers in general receive doses that are well below the maximum permissible levels, but that not infrequently these levels are approached, and occasionally exceeded. The greatest hazards were found to exist where surgical technic and the x-ray tube were in use simultaneously—as with screening for the removal of foreign bodies, angiography, cardiac catheterization, and cerebral angiography. Osborn cites also the danger arising from failure of lead-rubber equipment and advocates frequent testing of protective gloves and aprons. He believes the average diagnostic x-ray worker receives more radiation than the average radioisotope worker.

Binks (Part III) is concerned with more general aspects of the measurement of dosages received during radiation exposure. He stresses the importance of the absorbed dose, which is expressed in *rads*. The basic maximum permissible weekly doses recommended by the International Commission on Radiological Protection for whole-body exposure to roentgen and gamma rays of energy up to 3 MEV are 0.3 r (or rad) in the blood-forming organs, gonads and eyes, and 0.6 r (or rad) in the basal layer of the epidermis. For exposure of limited portions of the body, that is, hands and forearms, feet and ankles, or head and neck, the recommendation is for a maximum permissible weekly dose of 1.5 r in the skin, provided that in the case of irradiation of the head the weekly dose does not exceed 0.3 r to the lens of the eye.

Binks also discusses protection against "leakage radiation" from the x-ray tube, against the "useful beam" from the tube, and against radiation scattered from the patient, equipment, and walls and floor of the room. He recommends the use of a long cone on x-ray tubes, the incorporation of metal protection in both sides of fluoroscopic couches, avoidance of high-exposure areas by assistants working with fluoroscopists or holding children or other patients during radiography, dark-adaptation of the eyes at least ten minutes before commencing fluoroscopy, the use of minimum dose rates and minimum field sizes, the adoption of higher filtrations and higher kilovoltages, and the use of image intensification. He gives the figure of 50 r as the estimate of the lifetime dose which causes the doubling of the spontaneous mutation rate in different

species other than man. In considering possible effects on man he calculates that, on the basis of evidence that the average person below the age of thirty years has had about one diagnostic x-ray examination, the dose to the gonads per year is about 0.003 r for males and 0.01 r for females—which compares favorably with 0.1 r per year received from cosmic rays and from terrestrial sources, and with 0.03 r per year from the radioactive potassium in our bodies.

Two roentgenograms; 2 photographs; 4 figures; 5 tables.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Protection Measures in Roentgen Diagnostics with Reference to Doses Inducing Mutations. Ragnar Hol and Kristian Koren. *Acta radiol.* **44**: 471-478, December 1955. (State Institute of Radiophysics, Oslo, Norway)

Although the genetic sensitivity of man to radiation damage is as yet unknown, it appears reasonable to attempt to restrict the dosage received by the testes and ovaries from diagnostic roentgen examinations. The authors give the results of radiation measurements on a phantom at depths corresponding to the gonads, and review similar work by other investigators. They survey factors influencing the x-ray exposure and present means of reducing this, including shielding of the gonads when these lie in the middle of the field, good primary screening, the use of longer target-film distances, additional filtration, and replacement of single-phase (four rectification valves) by three-phase generators (six rectification valves) and increasing the kilovoltage. In fluoroscopy the screening time should be as brief as possible. The introduction of image amplification will alter the situation here, as only minimal doses will then be necessary.

Two diagrams; 1 table. B.-G. BROGDON, M.D.
Bowman Gray School of Medicine

Fluorescent Badges for Use During Fluoroscopy. D. K. Bewley. *Acta radiol.* **44**: 434-435, November 1955.

The disadvantage of film badges and pocket dosimeters is that they register only the total amount of radiation received up to the time of measurement. On the other hand, a piece of fluorescent screen will give warning of a dangerous level of radiation intensity if carried by staff members during roentgen screening procedures.

Such fluorescent badges were made of pieces of Levy-West mark 48 material with an insert of self-luminous zinc sulfide phosphor activated with radium at one microgram per square inch. The latter is almost unaffected by roentgen rays and serves as a standard of reference of brightness to which the fluorescence of the Levy-West screen may be compared.

At greater than 200 mr/hr., the self-luminous patch appears as a dark area on the brighter fluorescing background. It is invisible until the observer's eyes have become adapted to darkness, thus serving as a useful criterion of dark adaptation. J. A. CAMPBELL, M.D.

Indiana University Medical Center

The "Piccolo Male" of Radiologists. Bruno Belucci. *Arch. di radiol.* **30**: 423-428, Fasc. II, 1955. (In Italian) (Istituto di Radiologia dell'Università di Perugia, Perugia, Italy)

The term "piccolo male" (the Italian equivalent of

"petit mal," although of different meaning) is intended to express the vague, tired, rundown feeling experienced by the radiologist exposed to repeated small doses of ionizing radiation. It can be accompanied by latent hematologic changes which, under continued exposure, may become apparent as a slight depression of the red and/or white count and may even terminate in a fatal irreversible aplastic anemia.

This rundown feeling, which should be valued as a danger signal, is usually explained as due to long working hours in crammed fluoroscopic rooms and to lack of fresh air. It is known that in the "stress" syndrome, with neurovegetative disturbances, there is a decrease in the urinary excretion of 17-ketosteroids. A similar drop in urinary 17-ketosteroids has been found in radiologists during these periods of fatigue. The author postulates a radio-biochemical phenomenon, with possible effect of the ionizing radiations directly (or indirectly through a catabolite in the bloodstream) on the adrenal glands.

It would certainly be of great significance to find a laboratory test for detection, in the subclinical stage, of excessive exposure to ionizing radiation.

IRVIN F. HUMMON, M.D.
Cook County Hospital, Chicago

Distribution of Scattered Radiation in a Fluoroscopic Room. J. Cederlund, K. Lidén, and M. Lindgren. *Acta radiol.* **44:** 457-466, December 1955. (Roentgen-diagnostic Department, University of Lund, Lund, Sweden)

By measuring dosage of scattered radiation at multiple points in spatial distribution about units for both vertical and horizontal fluoroscopy, the authors were able to construct isodose curves for this radiation. A set of curves was made for each of several levels above the floor, as high as 2 meters, with utilization of standard fluoroscopic physical factors. The dosage is indicated in terms of milliroentgens per milliampere hour measured in air. With these curves one can note the locations receiving high or low dosage, in relation to personnel protection.

In addition, the percentage increase in scattered radiation with increase in size of the fluoroscopic field is demonstrated; and, of course, variation with changes in milliamperage can be easily determined. Changes related to variation in tube voltage or in tube filtration were not investigated.

One photograph; 14 diagrams; 1 table.

DAMON D. BLAKE, M.D.
Bowman Gray School of Medicine

Functional Radiotherapy. Part IV. Radio-Excitation. Pietro Del Buono. *Arch. di radiol.* **30:** 76-102, Fase. I, 1955. (In Italian) (Istituto di Radiologia Fisica dell'Università di Bari, Bari, Italy)

The destructive effect of ionizing radiation on tissue can be demonstrated by histologic methods; the electronic microscope will reveal even physicochemical changes thus produced. Many authors are of the opinion that these are the only possible consequences of ionizing radiation on living matter. Nevertheless, clinical findings and some laboratory tests would indicate the existence of a stimulating action of roentgen rays (and other ionizing radiations), under given circumstances, strongly influenced by dosage and time relationships.

Considerable speculation has been offered to explain the stimulating effect of radiation. The author believes that the most likely explanation is an overcompensating regenerative response of the injured cell, with protoplasmic changes (ionization, decreased pH, altered osmotic pressure, altered colloidal pH, etc.). Distant stimulation is said to occur through involvement of neurovegetative channels, with subsequent endocrine responses, either of existing glands or through the introduction into the circulation of metabolites originating in the injured cells.

The author stresses the point that no definite conclusions have as yet been reached and that further research in this direction would be desirable.

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On the Biologic Action of Ultrafractionated Radiation Second Communication: On the Effect of Ultrafractionation upon Tumor Selectivity. D. Hofmann and R. K. Kepp. *Strahlentherapie* **98:** 543-551, 1955. (In German) (Strahlenbiologischen Forschungsabteilung der Universitäts-Frauenklinik, Göttingen, Germany)

It has long been the suspicion of radiobiologists that the biologic effect of radiation emerging from the betatron and other commercially available accelerators is different from that of conventional radiations because in these new machines the beam is interrupted rhythmically. In order to test this thesis, the authors built three sources of artificially interrupted conventional radiation [which might appropriately be called "radiation sirens"].

One was a radium beta emitter and another a strontium-89 beta-ray source. In both of these the beam was interrupted by a spinning lead disk (mechanical "chopper") with 3,000 revolutions per minute. The third was a 60-kv x-ray machine with an electrical "chopper." The ratio of duration of radiation impulse to radiation-free interval could be varied. The following two ratios were employed: 1:10.4 and 1:2.25.

The tails of 1,164 white mice were inoculated with ascites carcinoma and the animals were irradiated with "chopped" radiation at a mean rate of 43 r/min., 65 r/min., 83 r/min., and 215 r/min., to total doses of 2,500, 4,000, 5,500 and 7,000 r and compared with a group exposed to an identical amount of continuous radiation at the same dosage rate from the same sources. The results were assessed separately as to (A) tumor response, (B) skin reaction, and (C) tumor selectivity (A/B).

Ultrafractionation was found to exert a remarkable effect on tumor eradication. In one experiment the tumor eradication rate dropped from 63 per cent to 8 per cent as a result of radiation "chopping." The skin reaction was likewise reduced by "chopping" but not always by the same amount as tumor eradication.

The authors reached the following conclusions: (1) Tumor effect and skin reaction are reduced by "chopping." (2) This phenomenon is less marked with x-rays than with beta rays. (3) Varying the impulse/pause ratio has a greater effect on tumor eradication when beta rays are used. (4) Consequently, "chopping" produces no improvement of tumor selectivity with beta rays, but some with x-rays.

[There is some doubt as to whether the x-ray machine used by the authors was really a source of continuous x-radiation when "chopping" was not employed. Whereas radium and strontium are without doubt

sources of continuous radiation, it is hard to believe that an x-ray generator could be built which is free of AC ripples. The authors have not presented any evidence that their x-radiation was continuous nor have they given a description of their machine or stated that they had convinced themselves of the continuity of their x-ray source. Most of their findings could be well explained by their having merely "chopped" an already "chopped" x-radiation and thus obtained a lesser effect with x-rays. This does not detract from the importance of their fundamental findings, namely, that "chopping" reduces the biological effect of any radiation.—G. S. S.]

One photograph; 5 graphs.

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On the Biologic Action of Ultrafractionated Radiation. Third Communication: On the Variation of the Protraction Factor in Ultrafractionation. D. Hofmann. Strahlentherapie 98: 552-557, 1955. (In German) (Strahlenbiologischen Forschungsabteilung der Universitäts-Frauenklinik, Göttingen, Germany)

In a further study of the effects of ultrafractionation, the author used two of the three radiation sources described in the paper abstracted above, namely, strontium-60 and the x-ray machine. The same "chopping" devices were employed. *Drosophila* eggs were irradiated and the impulse/pause ratios were 1:2.25 and 1:4.7. The dosage rates varied from 28 r/min. to 130 r/min. The total dosage necessary to produce the same biologic effect with the two set-ups was recorded. The results indicate that "chopping" influences the protraction factor. For the beta rays of strontium the effect was contrary to that for x-rays, though with continuous irradiation there was no difference between the two types of radiation in this respect. [The experiments with continuous radiation are described in another paper and are only briefly referred to here (*i.e.*, evidence for the second half of this statement is not presented). The published graphs merely indicate that with "chopped" x-rays the biologic effect rises with an increase in the dosage rate, whereas with strontium beta rays the opposite is the case when comparable "chopping" is employed.—G. S. S.]

Seven graphs. GERHART S. SCHWARZ, M.D.
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Effect of Minimal Doses of Total-Body Irradiation on the Ascites Carcinoma of the Mouse and on the Resistance of the Host. Franz Falk. Strahlentherapie 98: 518-542, 1955. (In German) (Anatomischen Institut der Universität Heidelberg, Heidelberg, Germany)

In a preliminary experiment, male white mice were subjected to total-body irradiation of 10 r (195 kv, h.v.l. 0.5 mm. Cu). Enlargement of the spleen and thymus as a result of this procedure reached a maximum one and a half to four days later, with return to normal after the seventh day.

Another group of mice of the same strain was then inoculated with ascites carcinoma intraperitoneally. Some of these were given 10 r twenty-four hours before inoculation, some 10 r twenty-four hours after inoculation, some no radiation at all. In the inoculated mice the response of spleen and thymus was greater than in the non-inoculated but irradiated mice. The radiation-induced splenic and thymic enlargement lasted longer in the inoculated mice, suggesting a defense mechanism

against cancer which is released by radiation but is stimulated to maximum development by the presence of cancer.

Total-body irradiation with 10 r was beneficial to the tumor-inoculated mice. The pre-irradiated as well as the post-irradiated animals lived seven to ten days longer than the non-irradiated tumor mice. Non-irradiated mice lived for ten to fourteen days, whereas the average life span of irradiated mice was nineteen to twenty-one days, with a maximum of twenty-four days.

The author concludes that small total-body exposures increase the tumor resistance of the host by stimulating the reticulo-endothelial system and lymphatic organs to the formation of basophil cells, which serve to combat the tumor. Similar tests with a dose of 30 r revealed a prolongation of life by an average of only five days.

[Freshly inoculated cancer is notoriously perishable and it is well known that it may be destroyed by small doses of x-rays, whereas after well established implantation larger doses are required for the same effect. The experiment would have been far more conclusive if the 10 r had been given seven days after implantation and had produced the same life-prolonging effect.—G. S. S.]

Thirteen illustrations; 6 tables.

GERHART S. SCHWARZ, M.D.
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Effects of Acute Whole-Body X-Irradiation on the Absorption and Distribution of Na^{22} and H_2O^+ from the Gastrointestinal Tract of the Fasted Rat. Charles J. Goodner, Thomas E. Moore, Jr., John Z. Bowers, and Wallace D. Armstrong. Am. J. Physiol. 183: 475-484, December 1955. (University of Utah College of Medicine, Salt Lake City, Utah)

Although earlier studies (1924, 1931, 1947) have demonstrated decreased intestinal absorption of certain substances in irradiated animals, there is no conclusive evidence that irradiation causes a true absorption defect. It has been shown, for example, that fat, protein, and vitamin A are absorbed at normal rates if associated changes in gastric emptying time, caused by irradiation, are taken into consideration.

The present studies, on rats, were undertaken to determine the effect of irradiation on the absorption of sodium and water, substances which are promptly and actively absorbed in the normal animal and are not dependent upon digestion or other secondary processes which might complicate interpretation of the role of irradiation.

First, following x-irradiation in the mid-lethal range, uptake curves were obtained by counting Na^{22} gamma activity over the tail as it increases during the process of absorption. Second, an attempt was made to follow the distribution of an orally administered dose of radio-sodium as it passed from stomach to systemic circulation, traversing the pylorus, mucosa, portal vein, and intrahepatic circulation. The rate of disappearance of the dose from the intestinal tract was found to be decreased at twenty-four, forty-eight, and ninety-six hours after irradiation. The maximum effect was present at forty-eight hours. Delayed gastric emptying was noted in the irradiated animals at forty-eight hours after exposure, but at the same time diminished clearing of radiosodium from the small intestine occurred. Thus, the rate-limiting factor in the absorption of sodium was the irradiated intestinal mucosa.

In the third phase of the study the rates of move-

ment of water and sodium were calculated forty-eight hours after a superlethal dose of x-radiation, by a modification of the method of Visscher *et al.* for determining rates of movement of substances across the intestinal mucosa (Am. J. Physiol. 142: 550, 1944). This analysis of the rate of movement of sodium from the intestine was found to be in agreement with a similar analysis of the data from the uptake studies. The effect of irradiation upon absorption of both water and sodium was to increase the rate of movement of these substances into the intestine from the blood, as well as to decrease their outward flow. The net flow in the irradiated animals was from blood to intestine, while the direction in the control animals was the reverse.

Measurement was made of the radiosodium space of the liver at forty-eight hours after a mid-lethal dose and a definite increase of sodium-free water in the irradiated livers was found, without increase in dry weight or sodium space.

Eight figures; 3 tables.

Role of the Kidney in Development of Vascular Hypersensitivity Following Whole Body Irradiation. David F. Bohr, P. A. Rondell, L. E. Palmer, B. L. Baker, and F. H. Bethell. Am. J. Physiol. 183: 331-334, November 1955. (University of Michigan Medical School, Ann Arbor, Mich.)

Kidney shielding was found to reduce the incidence of increased vascular sensitivity in irradiated rats in the second week post-irradiation. Also, kidney-shielded animals were in better condition than the control animals. It is suggested that the vascular hypersensitivity during this period parallels the incidence of general debility rather than reflecting the presence of a renal vasoconstrictor material. This interpretation is substantiated by the observation that kidney irradiation without whole-body irradiation fails to increase vascular sensitivity. No histologic change was detected in the irradiated kidney.

Two photographs; 2 figures; 1 table.

Effect of Kidney Shielding on Survival Following Whole Body Irradiation. David F. Bohr, P. A. Rondell, L. E. Palmer, and F. H. Bethell. Am. J. Physiol. 183: 335-339, November 1955. (University of Michigan Medical School, Ann Arbor, Mich.)

Having studied the role of the kidney in vascular hypersensitivity (see preceding abstract), the authors undertook to determine the effect of kidney shielding on survival following whole-body irradiation of the rat. A highly significant degree of protection against the lethal effects of whole-body irradiation was afforded by shielding the exteriorized kidneys alone. Even greater protection resulted from shielding superficial structures in the lumbar region of the back.

Emphasis is placed on the striking parallelism between the degree of protection observed in the current studies and that reported in the literature from the shielding of diverse isolated structures in the rat. In considering the mechanism by which kidney shielding affords its protection, it seemed necessary, therefore, to recognize the possible importance of a non-specific factor, not associated with the primary physiological functions of the shielded part. Possible protective mechanisms involving specific renal function were also considered. A locally raised strain of Wistar rats proved to be more sensitive to the lethal effects of

whole-body irradiation than did a commercial strain of Sprague-Dawley rats.

One roentgenogram; 1 photograph; 1 graph; 2 tables.

Enzymatic Activity of Radiated and Normal Salivary Gland Tissues. James A. English. Am. J. Physiol. 183: 463-474, December 1955. (Naval Medical Research Institute, Bethesda, Md.)

The early changes that occur in the salivary glands of rats following irradiation were investigated from a metabolic point of view. The activities of several enzymes involved in the metabolism of carbohydrate were studied by observing changes in optical density which occur in coenzymes required in the enzymatic reaction. The assays were performed on supernatant fractions of centrifuged homogenates of the submaxillary-sublingual salivary glands of animals irradiated locally over these glands one to twenty days prior to killing. Within two to three days following irradiation with 3,000 to 5,000 r (200 kvp), significant increases were observed in the activities of glucose-6-phosphate and isocitric dehydrogenase when the activities were related to the total protein content of the sample. The total activities for the whole salivary gland for the average animal did not increase, however, because of a glandular weight loss following exposure. The total activity for glucose-6-phosphate dehydrogenase remained within the range of non-irradiated animals, while isocitric dehydrogenase was significantly decreased between the fourth and fourteenth days but tended to rise toward the end of the twenty-day study period. The possible relationship which these findings may have to changes in salivary flow following irradiation is discussed.

Eight figures; 3 tables.

Effect of Morphine and N-Allylnormorphine on Radiation Mortality. Howard L. Andrews and Ervin J. Lillegren. Am. J. Physiol. 183: 322-324, November 1955. (National Cancer Institute, Bethesda, Md.)

Previous experiments showed that preliminary administration of morphine reduced irradiation mortality in mice, possibly as a result of depression of the respiratory center. It seemed of interest, therefore, to determine the effects of compounds similar structurally to morphine but with a different respiratory effect. In view of the remarkable antagonism between the pharmacologic actions of morphine and N-allylnormorphine (nalorphine), comparative studies of the action of these drugs against radiation were undertaken.

It was found that either drug, given alone prior to x-irradiation, produced a significant decrease in twenty-eight-day mortality. Morphine had a definite protective action at 600 r (LD 80 in the mice used), which was lost at 660 r (about LD 100). Nalorphine was quite effective at 600 r, but its range of usefulness was also limited. The authors consider that interest in the latter compound lies in the mechanisms by which it acts rather than in its use as a practical prophylactic agent.

Mixtures of the two drugs had little effect on the mortality statistics. Although the mechanisms of action are not known, low oxygen consumption or a depression of cholinesterase activity cannot account for the results.

Two figures; 2 tables.

Radiophosphorus Metabolism of the Guinea Pig Heart and the Actions of Digitalis and Pentobarbital.
Stewart C. Harvey. Am. J. Physiol. 183: 559-564, December 1955. (University of Utah College of Medicine, Salt Lake City, Utah)

The incorporation of P^{32} into inorganic phosphate, ester phosphates, adenosinetriphosphate, and phosphocreatine of the guinea-pig heart *in vivo* was studied. Phosphocreatine was found to incorporate P^{32} at a rate faster than can be accounted for by synthesis *via* adenosinetriphosphate. An independent pathway of phosphocreatine synthesis or an inhomogeneity in donor adenosinetriphosphate is postulated. Phosphocreatine appeared to incorporate P^{32} from the extracellular phosphate rather than from the intracellular inorganic phosphate; otherwise an inhomogeneity in donor phosphate must be postulated. Digitalis decreases the myocardial content of phosphorus in each of the organic fractions and increases the content of inorganic phosphate. Pentobarbital anesthesia affects the phosphate metabolism qualitatively in the same manner as does digitalis, except that it increases the myocardial content of phosphocreatine. Digitalis tends to restore the phosphocreatine content to normal, whereas it weakly synergizes with pentobarbital on the other phosphate fractions. The effects of digitalis and

pentobarbital are discussed in relation to the mechanism of the action of digitalis. A pitfall in the use of pentobarbital in studies on phosphorus metabolism is emphasized.

One graph; 4 tables.

Pulmonary Effects from Radioactive Barium Sulfate Dust. H. Cember, T. F. Hatch, J. A. Watson, and T. Grucci. Arch. Indus. Health 12: 628-634, December 1955.

Rats were exposed by intratracheal insufflation to radioactive barium sulfate particles at three levels of exposure, namely, 4.5 mc., 4 μ c, and 4.5 μ c of radiosulfur, and were serially killed over a nine-month period. A very small increase in the intensity of inflammation and cicatrization was observed in the animals that received the highest dose. This increase, however, was not considered significant and was not attributed to the radiation. The authors suggest that the intense radiation dose delivered to the small volume of lung tissue in the immediate vicinity of the barium sulfate particles may not be as hazardous as might be expected or that the latent period for production of serious radiation injury is very much longer than the nine-month period over which these animals were observed.

Nine figures, including one autoradiogram.



